

JUL 6 1926

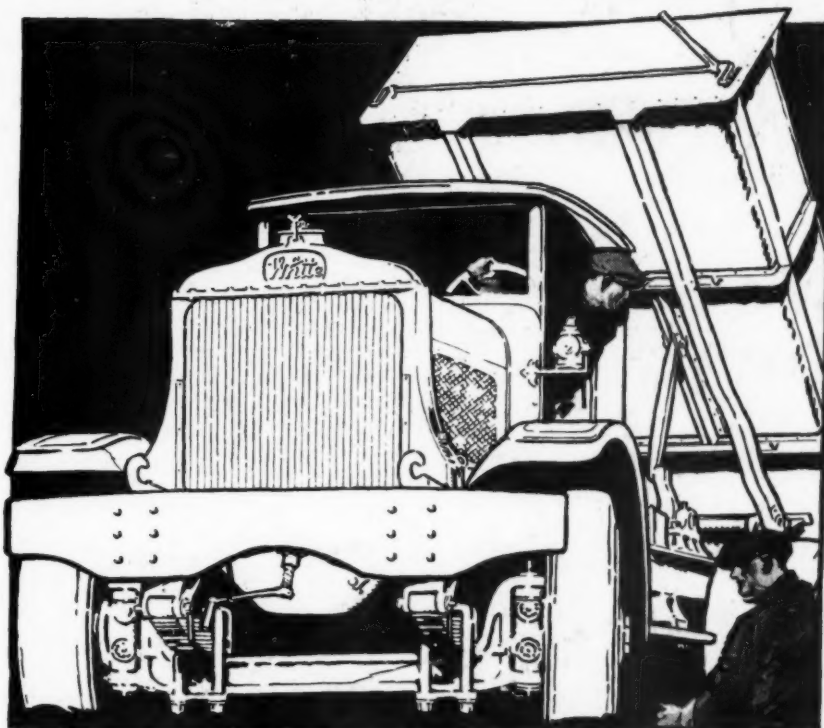
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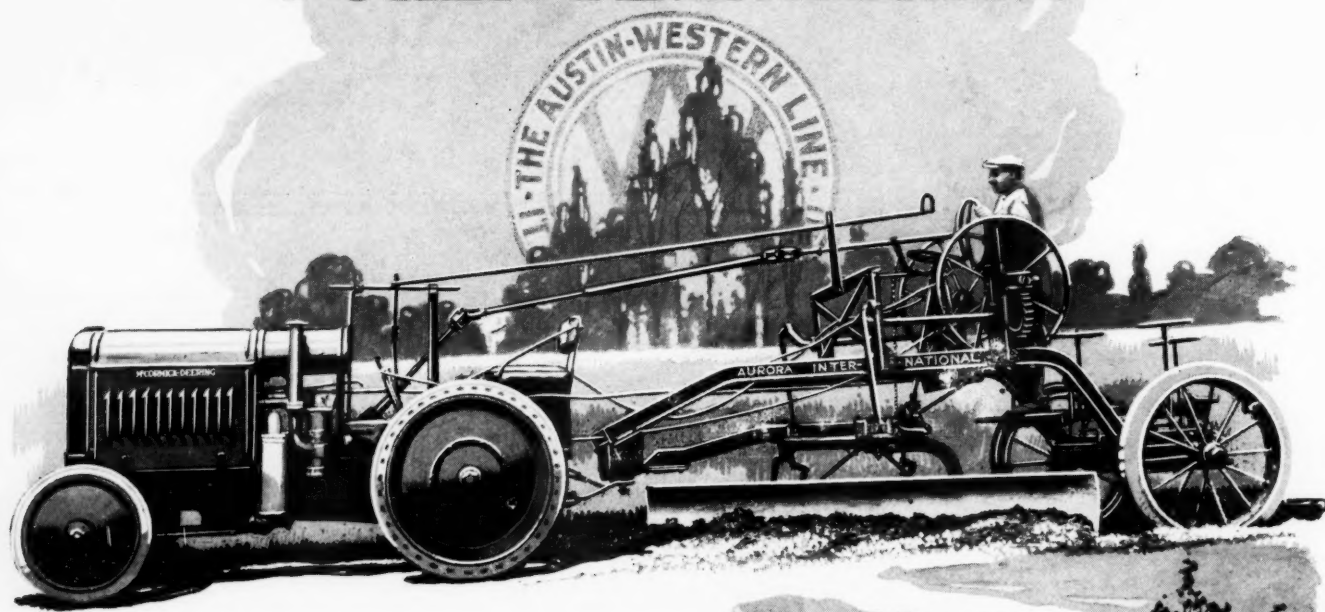
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PUBLIC WORKS

CITY COUNTY STATE

A Combination of "MUNICIPAL JOURNAL" and "CONTRACTING"

Vol. 57

July, 1926

No. 6

New Washington Filter Plant*

A rapid filter plant of eighty million gallons capacity to supplement slow sand filters built twenty years ago. Unusually compact layout. Filter operation controlled by water level in clear water reservoir. Alum to be manufactured at plant. Special attention to architectural features.

Washington, D. C., obtains its water supply from the Potomac river, with an area of water shed above the intake of 11,050 square miles and an average discharge of 8,000 million gallons per day. The water is generally quite muddy but the mud is easily filtered out and in some cases aids purification by promoting rapid sedimentation with aluminum sulphate. The population on the water shed is unusually small and there is comparatively little pollution of the water. The general character of the water is indicated in the following average analysis: maximum turbidity, 4,000; average turbidity, 200; hardness, 63 p. p. m.; chlorine, 3.1 p. p. m.; bacteria, 4,000 per c. c.; B coli, 4 per c. c.

The water is led from an intake about fifteen miles from the city to several settling and storage reservoirs. Twenty years ago a slow sand filtration plant was built which has given

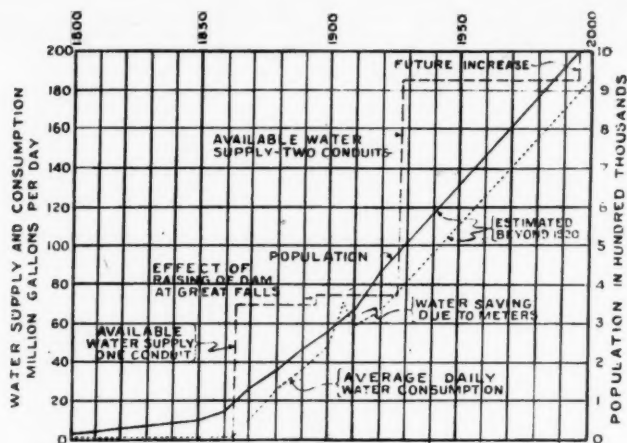
excellent service, but the capacity of which has been reached. The city has been growing rapidly during the past few years and, after many investigations, it was decided to build a new aqueduct parallel to the present one, and a new filtration plant, this one to be of the rapid sand variety. The total new work, which is estimated to cost about nine million dollars, includes several other pipe lines and reservoirs and also a power plant which will utilize the surplus water brought by the two aqueducts above that needed for the supply of the city. The site of the new filter plant is 150 feet above the Potomac river and furnishes an excellent opportunity for locating a 2,400 k. w. hydro-electric plant for this purpose, which will furnish electric energy for operating the filter plant and for pumping filtered water to all the high service areas in the district.

The site selected is near Dalecarlia reservoir, one of the largest reservoirs of the system with a capacity of about 100 million gallons, which will act as forebay for the power plant and as

*Condensed from a paper before the American Waterworks Association by Philip O. Macqueen, U. S. Assistant Engineer.



HEAD HOUSE AND FILTERS UNDER CONSTRUCTION ON MAY 21, 1926



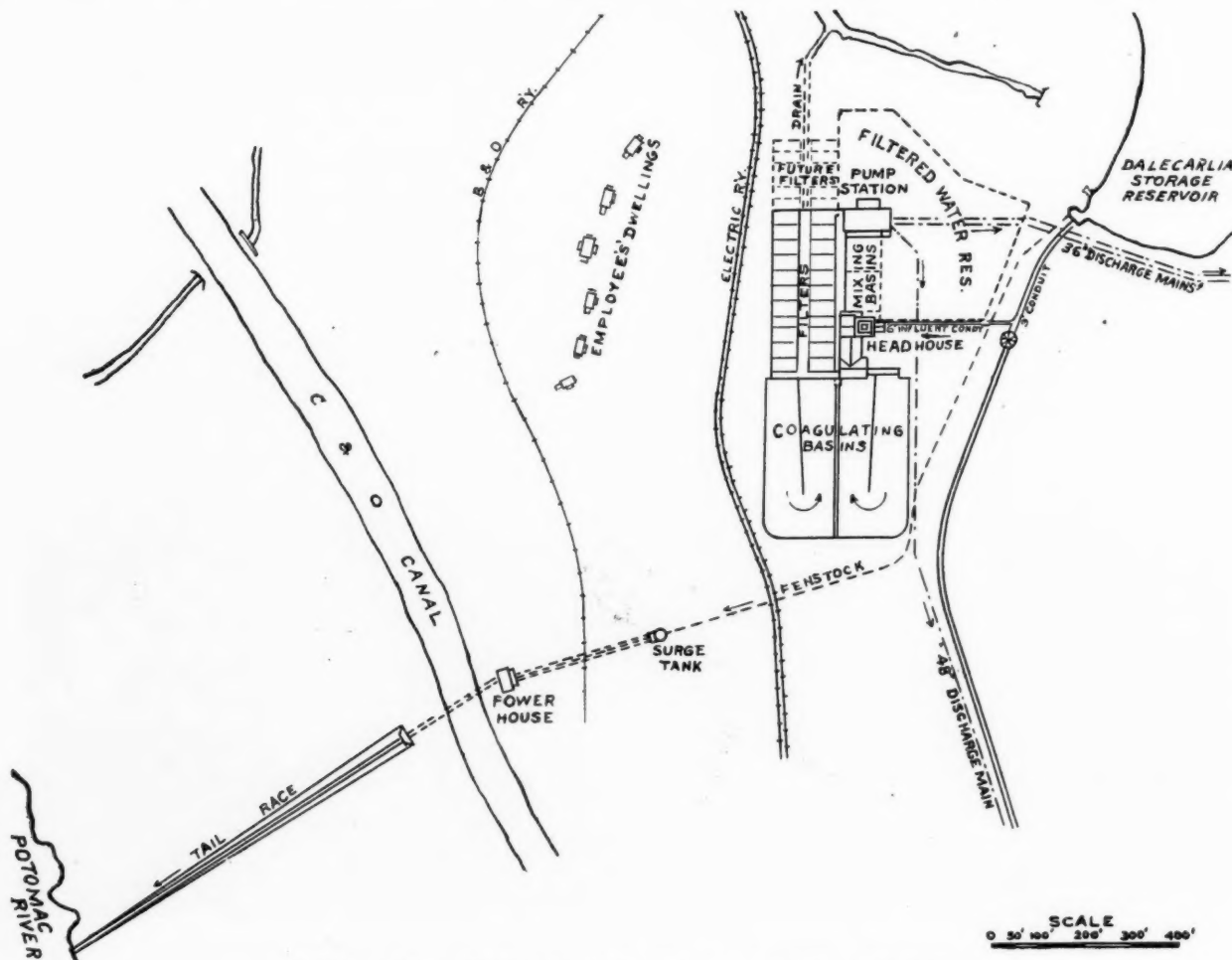
POPULATION AND WATER CONSUMPTION CURVES FOR THE DISTRICT OF COLUMBIA

settling reservoir for the purification plant. The United States owns a large area of land around Dalecarlia reservoir but only about ten acres of this was level enough for a filtration plant layout and this was cut in two by an electric car line. This necessitated compactness of layout. Separate walls were eliminated, water passages were shortened and all buildings were placed under one roof. The control chamber was placed under the floor of the head house; the filtered

water reservoir in a small valley adjacent to the filters, and the pumping station in a corner of the filtered water reservoir near the filters.

A careful subsoil survey of the entire area was made, wash borings being carried down ten to thirty feet at fifty feet intervals; as a result it was determined the various structures should rest on red or yellow clay or a mixture of these with rock. The greatest load to be carried by the foundations will be the head house tower, 150 feet high and weighing about 3,000 tons. This is supported by a heavily reinforced concrete mat 49 feet square and 4 feet thick.

Control Chambers—Raw water flows by gravity from the Dalecarlia storage reservoir, which is only about 600 feet away, and enters the plant through a 6-foot diameter concrete conduit, passing first through the control chamber. This structure is a compact series of sluice gates and intersecting water passages located near the central point of the filtration plant, similar in a general way to the cross-connection gate houses found in larger filtration plants. Treated water, settled water and filtered water all pass through separate passages of the control chamber, thus providing the limit of flexibility. In case of necessity the treated water can be passed directly to the settling basins or the filters; the water from the mixing basins can be passed directly to



PLAN OF NEW FILTRATION PLANT AT WASHINGTON, D. C.

the filters, or the raw water can be passed directly to the filtered water reservoir and the pumping station. The necessity of such extremes in operation are, of course, remote but by no means impossible.

An equally important function of the control chamber is to provide a central point for the application of alum and chlorine. The alum solution can be applied to the water before and after passage through the mixing chambers and also to the settled water before it passes through the filters; or if desired a small dose of alum can be added to the water at any stage. This unusual flexibility is expected to be of value in obtaining the best results in the process of coagulation. The chlorine is also applied to the filtered water at the control chamber.

Due to the central location of the control chamber chemical feed lines are extremely short. With the mixing chambers operating in series, the alum feed line is only about 10 feet long, and branches to other water passages are only about 20 feet long. The chlorine line is 30 feet long. These relatively short lines will simplify chemical feed operation considerably.

When mixing basins are operated in parallel, the alum will be applied at a small gate chamber on the raw water influent conduit about 300 feet from the control chamber, so that the solution will be evenly divided before it reaches the mixing basins.

Mixing Basins—After the alum has been applied to the raw water it flows to two mixing basins. These basins, 80 feet square and 18 feet deep, are fitted with baffles of the "around the end" type, which will be used for thoroughly combining the chemicals with the raw water. The baffles will be constructed of $\frac{7}{8}$ " tongue and groove lumber braced throughout with 4"x4" struts, so as to support the thrust due to the maximum loss of head. Each basin will contain 20 passages 4 feet wide and 80 feet long, making a total travel of 1,600 feet per basin. Provision is made for using the basins either in series or in parallel, and further flexibility of operation is provided by an extra effluent gate near the half-way flow point in each basin.

Mixing periods of 8, 14, 19 and 27 minutes, with a velocity of 2 feet per second, can be obtained with a flow of 80,000,000 gallons per day and with the basins operating in series. With the basins in parallel and the same flow the mixing periods can be made 14 or 27 minutes, with a velocity of 1 foot per second. Normal losses of head under these conditions will be from $\frac{1}{2}$ to 2 feet. With flows of 60,000,000 or 40,000,000 gallons per day, mixing periods will be lengthened and losses of head decreased.

Experimental work with mixing basins is always advisable where possible when a new filtration plant is being tuned up and long and short mixing periods are used until the best working conditions are found. As shown by the above figures the range of operation of the mixing basins will be wide enough to get results and also meet changes which are constantly occurring in the raw water.

Friends and enemies of the "around the end" type of baffles are about equally divided. In this case in Washington it was the desire to operate with the smallest loss of head possible and to have the water level in the mixing basins, coagulating basins and filters rise and fall in parallel with corresponding changes of level in the Dalecarlia raw water storage reservoir. Under these conditions "around the end" type baffles were practically required.

Settling Basins—From the mixing basins the water flows through a 5'x9' concrete duct, about 200 feet long, to the two coagulating or settling basins which are located at the south side of the filtration plant. These two basins are open concrete structures 333 feet long, 150 feet wide and from 17 to 12 feet deep, and are separated by a substantial concrete dividing wall. Each basin is provided with a light concrete baffle wall which causes the water to travel the full length of the basin and then return to a point opposite the influent. The baffle wall is constructed on an angle of about 5 degrees towards the central dividing wall, which will tend to cause the water to move more slowly at the half-way and end points of its flow in the basin. Experiments made at Baltimore indicate that this arrangement will facilitate sedimentation.

Water will enter the basins at one end near the bottom through four sluice gates 48" square, and will then be deflected upwards with wooden baffles. Five sluice gates of the same size are provided for the effluent.

When the basins are operating in parallel, which will be the normal condition, and the flow is 80,000,000 gallons per day, the settling period will be approximately 3 hours and the velocity of the flow will be 3 feet per minute. With a flow of 40,000,000 gallons per day, which will be used for a good many years, the settling period will be about 6 hours and the velocity $1\frac{1}{2}$ feet per



FILTERS UNDER CONSTRUCTION MAY 21, 1926

minute. The sedimentation periods can be shortened if desired by passing the water through the dividing wall, which is constructed with a hollow core.

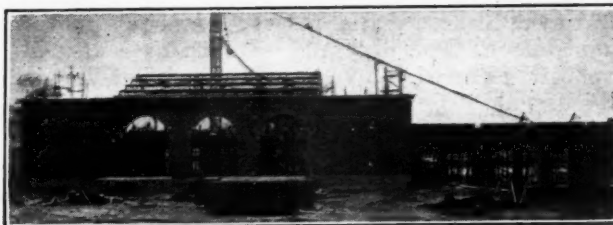
The floors of the basins have slopes of 10:1, which will facilitate cleaning. Pressure lines with 2½-inch hose connections are provided at suitable intervals for washing, also an 18" low pressure flushing line with 10" gate valve outlets 50 feet apart. One basin can be cleaned while the other is in service, thus avoiding shutting down the plant.

Filters—The filter building is 36 feet long and 155 feet wide, and contains 20 filters arranged in two parallel rows of 10 each, separated by a central pipe gallery. Each filter is a rectangular concrete structure 54 feet long, 31 feet wide and 15 feet deep, with a net sand area of 1,477 square feet. Using the rates of filtration of 125 to 150 million gallons per acre per day, the filter capacities are 4,238,000 and 5,086,000 gallons per filter per day, respectively. The filters are considered as 4,000,000 gallons per days units, but it is recognized that 5,000,000 gallons per day is not by any means excessive, and controllers, piping and equipment have been designed for flows varying from 1,000,000 to 6,000,000 gallons per day. Taking into consideration filters out of service and wash water demands, the maximum net output of the plant may be safely taken as 80,000,000 gallons per day. Each filter will be equipped with one 20" Simplex rate controller and five Rensselaer hydraulically operated gate valves.

The strainer system used will be of the new open wooden slat type, similar to that now being installed in the new Baltimore plant. The slats will be 1"x8" yellow pine spaced so as to allow openings of 1" between the slats. Below the strainer system there will be a shallow water passage 24" deep in the center and approximately 6" deep at the sides of the filter. This cross-sectional area, amounting to about 35 square feet, will give adequate opportunity for wash water to exert an equal upward current over the entire area of the filter. Wash water gutters are of concrete and are spaced 6'9" center to center, and 4' 0" in the clear with the main gutters on one side of the filter. Gravel and sand will be 18" and 30" deep, respectively. The top of the sand will be 21" below the top of the gutters, thus allowing for a vertical velocity of wash water of 2 feet or more per minute. Consideration has been given to providing adjustable brass or wooden plates on the sides of the lateral gutters so as to wash at higher velocities if found advisable.

Tops of filters have center and three cross walks, so that any part of the filter can be inspected with perfect ease. These walks are so generous in size that the usual railing between filter tops and central operating floor will be omitted and visitors will be allowed to walk any place in the filter building.

Pumping Plant—The pumping station, which is directly connected to the north end of the filtration plant group of buildings, contains nine elec-



PUMPING STATION UNDER CONSTRUCTION

trically operated pumps which are used to force water to various service reservoirs in the city. The building is 100 feet long and 46 feet wide, with a 46'x20' wing on one side for housing the switchboard and electrical equipment. All the pumps are placed low enough so that negative suction heads will be eliminated under normal operating conditions. Discharge pipes and valves are in a sub-basement under the main pump floor, so as to improve the architectural appearance of the interior of the pump room. The filtered water reservoir is on three sides of the pumping station, and the mixing basins are on the fourth side, so the building is entirely surrounded by water.

Water flows to the pumps through a concrete suction well which connects directly to the filtered water reservoir, and branch concrete suction chambers 3 feet wide and 7 feet deep lead off at right angles from the suction well to the various pumps. Maximum velocities in these passages are less than 3 feet per second so that the loss of head is extremely small.

After leaving the pumps, the water is forced into three separate cast-iron discharge mains, which pass through the filtered water reservoir on the way to the high level reservoirs. The largest of these discharge mains is 48" in diameter and it is necessary to anchor it to the concrete floor of the reservoir with steel straps to keep it from floating when empty. The other 36", Class D cast-iron discharge pipes are heavy enough to avoid the necessity of anchors.

The sizes and capacities of the pumps are shown by the following table:

| Data | 1st High Service | 2nd High Service | 3rd High Service |
|-------------------------------|------------------------|------------------------|------------------------|
| Number of pumps | 3 | 3 | 3 |
| Normal capacity M. G. D. | 18 | 10 | 10 |
| Maximum capacity M. G. D. | 22 | 12 | 12 |
| Average operating head (feet) | 155 | 235 | 340 |
| Motor horse power | 615 | 510 | 770 |
| Speed, revolutions per minute | 1,200 | 1,200 | 1,200 |
| Guaranteed overall efficiency | 79% | 78.9% | 79.2% |

The pumps will be of the horizontal, volute type with a single stage for the low lift and two stages in series for the two high lifts. Motors will be of the self-starting, synchronous type, designed to operate on a 3 phase, 60 cycle, 2,200 volt circuit at 100% power factor. The pumps were built by the Worthington Pump & Machinery Corporation and the motors by the Westinghouse Electric Manufacturing Company.

Filtered Water Reservoir—After leaving the filters the water passes through a concrete duct 4'9" high, 9'6" wide and 250 feet long, to the

filtered water reservoir, which is located on the northeast side of the plant. The reservoir is a covered concrete structure with a storage capacity of 15,000,000 gallons, acting as a local balancing factor between the filters and pumps. The water enters the reservoir near the pumping station but will be forced to circulate by baffles in such a way as to avoid dead water.

The shape of the reservoir is quite irregular with a maximum length and width of about 400 feet, and an average depth of 20 feet. Outside walls were built to follow the contours so as to avoid, as far as possible, any construction on filled ground. The roof is of the flat slab type, 9 inches thick, with a four-way system of reinforcement. Columns are circular, 24" in diameter and spaced 16'6" center to center. Side walls have a heavy gravity section. The floor is of the inverted groined arch type, 6 inches thick at the low point and 18 inches thick under the columns. Floor joints are sealed with 6"x24" concrete blocks with the top surfaces and vertical joints coated with plastic cement.

The reservoir operates on a somewhat different principle than the average filtered water reservoir. The maximum flow line is on a level with the tops of the filters so that when the reservoir is full the filters automatically cease to operate. As the water level in the reservoir drops the filters begin to operate and gradually attain a maximum capacity when the reservoir drops down to or below the level of the filtered water effluent weir, which acts as a water seal for the controllers. Operation of the reservoir in this way will not only effect a considerable saving in the cost of pumping, but will tend to simplify the joint operation of the pumps and the filters as, if the pumps are slowed down, the water in the reservoir would rise and force the filters to slow down.

The capacity of the reservoir below the water seal of the controllers is only about 50% of the full capacity, but as Washington has four other large filtered water reservoirs in other parts of the city the decreased capacity of the reservoir at the plant is not a material loss to the general filtered water storage system. Smaller cities with a single filtered water reservoir would be unable to operate in this way.

Venturi water meters made by the Builders Iron Foundry are placed on the three discharge lines from the pumping station, also on the raw water influent conduit, the filtered water effluent conduit and the wash water reservoir effluent.

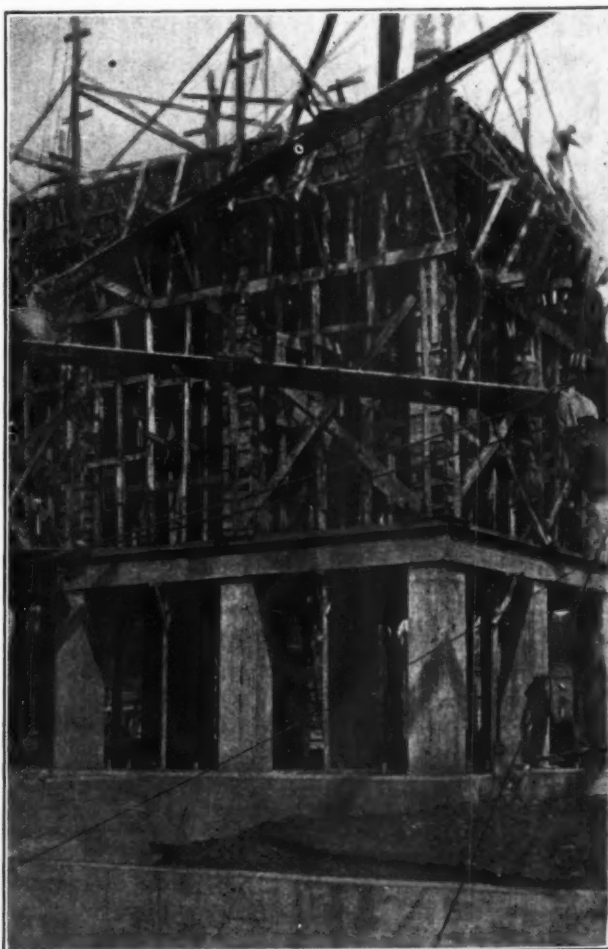
Other Fixtures—Rectangular concrete ducts or passages, instead of large pipes, are used for conveying the water through the filtration plant. These ducts are from 8 feet to 10 feet wide, and from 5 feet to 12 feet high, with walls 12 inches to 15 inches thick. As a rule expansion joints with steel plate water stops are provided throughout at intervals of less than 50 feet, and inside surfaces of all ducts will be waterproofed with one of the special compounds for concrete protection now on the market. The ducts are

heavily reinforced for positive and negative stressed for all loading conditions and also for temperature strains.

Some doubt has been expressed by sanitary engineers as to the advisability of having raw water and filtered water separated by relatively thin concrete walls. Consideration was given to this question but the writer can hardly see how it would be of much importance on account of the extremely small leakage possible and the relatively large quantities of water involved. All multeducts will be thoroughly tested under full water pressure conditions before being finally accepted.

The wash water reservoir is a covered concrete structure 66 feet long, 35 feet wide and 12 feet deep, with a capacity of 200,000 gallons, and it will be located on the side of a small hill directly east of the filtration plant. As the base of this hill is only 300 feet from the filtration plant and it rises to an elevation of several hundred feet above the filters, it provides an ideal situation for the reservoir. The flow line of the reservoir is 54 feet above the tops of the filter gutters, and it has been calculated that this will provide ample head under full flow for washing the most distant filter.

A 12-inch pipe connected to the discharge of the first high service is used to fill the reservoir,



HEAD HOUSE TOWER AT ONE-THIRD HEIGHT

and a 30-inch cast iron pipe 1,200 feet long conducts the wash water to the filters. An automatic float valve will be used to keep the wash water reservoir full at all times. The roof of the reservoir is covered with two feet of earth and the slopes are terraced so that the finished structure will be entirely out of sight and thoroughly protected from contamination or freezing.

Syrup of alum will be used as a coagulant and this material will be manufactured at the filtration plant, by the Hoover process, out of bauxite and sulphuric acid. A careful estimate, including cost of raw materials, preparation, and also interest and depreciation, indicates a saving by this process of about 20% in the cost of chemicals. Ability to control the acidity of the alum syrup is, however, counted upon as being of more importance than the difference in cost of materials.

Bauxite will be transported to the plant by motor truck from a railroad siding half a mile away. After being crushed and pulverized it will be lifted by vacuum to the storage bins in the tower of the head house. From these bins it will be drawn off as required to lead lined boiling tanks.

Sulphuric acid will be stored in an underground vault near the head house, and will be lifted to the tanks by compressed air. The manufacture of one ton (2,000 pounds) of aluminum sulphate will require about 700 pounds of bauxite, 1,100 pounds of 60 degree sulphuric acid and 200 pounds of water. Auxiliary equipment such as automatic scales, acid fume scrubbers and dust collecting equipment will be used to facilitate the work and to keep the alum plant clean. After the syrup has been made the solution will be diluted and fed to the raw water through controllers. One of the storage bins will be used for a supply of crystal alum to be used in case of necessity. Cake alum will not be manufactured at the plant.

The hydro-electric plant is located at the foot of a steep bank about 1,000 feet away from the filtration plant. Water pressure for operating the turbines will be obtained from the surplus supply from the aqueducts, which will amount to a maximum of 200 cubic feet per second under a net head of 130 feet. Electrical equipment in the power plant will consist of three horizontal 1,200 K. W. generators delivering three phase, 60 cycle, 2,200 volt current. The power plant will be of the remote control type fully equipped with all safety devices and will be operated from the pumping station switchboard at the filtration plant. Standby service connections with a local power company have been made in case of a break down in the power plant. The cost of local electric power is about 1 cent per K.W.H. and the cost from the new power plant will be $\frac{1}{4}$ of a cent per K.W.H., which will mean a saving of approximately \$100,000 per year. The power plant will furnish sufficient energy for all requirements of the filtration plant and pumping station.

ARCHITECTURAL FEATURES

As the plant is located in a residential section and near a proposed parkway, unusual attention was given to the architectural features of the buildings. The American Colonial type was selected, using dark red brick and white wooden gables, and the plans were approved by the Fine Arts Commission of the national capitol. The roof will be of variegated Vermont slate. In order to obtain the exact appearance of brick work desired by a combination of colors ranging from light red to dark brown, a sample wall, 10 feet high and 20 feet long, was erected on the site of the work and the contractor required to use it as a model for color and bond.

The more important interior floors of the building will be covered with a light red and tan colored pottery tile. The filter building will be exceptionally well lighted, the ceilings and columns being white, floors and main passages of red tile, and the filter tops finished cement; while there is generous provision of windows and skylights. The interior treatment of the pumping station and head house will be similar to the filter plant, and pumps and motors will be painted white. Materials will be selected for durability as well as beauty and the appearance of the buildings should improve with age. Six small brick dwellings matching the architecture of the main group will be built near the filtration plant for the employees.

The studies, plans and construction of the new filtration plant, aqueduct and other water supply structures are under the office of the chief of engineers of the War department. Work on the project was begun by Major M. C. Tyler, corps of engineers, who continued in charge until 1923 when he was transferred to Muscle Shoals and succeeded by Major J. A. O'Connor, corps of engineers, who is now in charge of the work. E. D. Hardy, associate engineer, is in direct charge of design and construction, J. E. Curtis is superintendent of construction of the entire project, and the author of the paper, Philip O. Macqueen, is in charge of the drafting room and in direct charge of the construction of the filtration plant under Mr. Curtis. J. W. Armstrong, filtration engineer for the city of Baltimore, is consulting engineer on the work and many of his ideas will be recognized in the Washington filters by those who are familiar with them.

Studying Boston Garbage Disposal

James H. Sullivan, commissioner of public works of Boston, at a recent interview with representatives of the Women's Municipal League of that city, stated that within a year or so the city would undoubtedly install an incinerating plant for disposing of refuse and garbage as a test plant. There is, however, little prospect that a general change to incineration will be made for some time to come, in spite of the objectionable features of disposal at the rendering plant at Spectacle Island, since the expense of incineration would be much greater than disposal at the present plant, and the existing garbage removal contract has six years yet to run. How-

ever, the growth of the outlying districts has been so rapid that additional facilities must soon be provided and it is probable that an incinerating plant will be installed for this purpose in one of these districts, to be followed by others if it should prove successful.

Garbage Disposal in Cleveland

Nearly one hundred and fifty thousand tons treated by the reduction system. Collected from 121 districts by horse-drawn wagons and five-ton trucks and carried six miles by rail.

By C. C. Smith*

Cleveland, Ohio, has the distinction of being the first American city to own and operate a complete system for the collection and disposal of garbage. This municipal service began in 1905 under the administration of Tom L. Johnson, when the city acquired the property of the company which was then performing this service.

When it first took over the garbage collection and disposal, the city collected about 24,687 tons a year, but by 1925 this had increased to 143,000 tons; the pounds per capital increasing from 110 in 1905 to 299 in 1925.

The city is now divided into 121 collection districts, 49 of which, comprising the down-town and outlying sections, are served by five-ton motor trucks, while in the intermediate section horse-drawn vehicles are used. This arrangement eliminates long wagon hauls. All collections concentrate at one point; where the garbage is loaded into special water-tight steel cars, (also, the collection equipment is housed here.) Each day's accumulation is transported by rail to the reduction plant, located about six miles from the loading station and 1½ miles outside the city limits. Here the garbage is unloaded in a receiving building where it is stored until the start of its journey through the reduction system.

The reduction system includes a cooking

*Superintendent, Division of Garbage Reduction, Cleveland, Ohio.

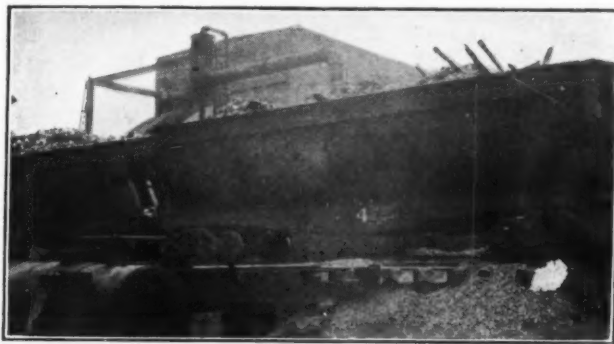
equipment consisting of 41 Chamberlain digesters, 33 of which have a capacity of 3½ tons each and 8 a capacity of 5 tons.

After being cooked for a period of four to six hours (the duration of cooking depending upon the season and its effect upon the composition of the garbage) and steam-pressed in the digesters, the material is removed and passed on through continuous roller presses, where the moisture content is reduced to about 55 or 60 per cent. It is then rough screened for the removal of cans, rags, etc. and then continues to the steam heated dryers. Roller presses were substituted in 1923 for the direct heat dryers which had previously been used for the preliminary drying.

The steam drier equipment is composed of four units, one of which is held in reserve. These dryers are unique in design and have a heating surface three times greater than the old type of dryer of equal size. As this was the first garbage plant to be equipped with a steam tube dryer, some anxiety was felt as to the practicability of the machine when working on city garbage. It was soon demonstrated, however, that they were adapted for this class of work and they have been used exclusively for the past three years.

After the garbage has been dried, the fats are recovered by the use of a solvent. The residue tankage is sold direct to farmers and has almost wholly replaced manure as a fertilizing agent in the vicinity of Cleveland.

The cost of collection in 1925 was \$4.38 a ton, including depreciation. The reduction cost, also inclusive of depreciation, was \$2.67 per ton, which was virtually offset by the earnings.



GARBAGE CAR, 70 CUBIC YARDS CAPACITY



COLLECTION WAGON, 2½ YDS. CAPACITY



COLLECTION TRUCK, 6 CUBIC YARDS CAPACITY

Transverse Tests of Concrete*

To determine strength of pavement acting as a beam. Results much more uniform than those of compressive tests. Apparatus designed for these tests.

It is of primary importance in designing a concrete pavement to be able to predict within reasonable limits the actual strength of the completed slab. As Portland cement concrete has been used in the past principally where it has been subjected to compressive stresses, the compressive test has come to be general practice, and it has been carried over into the field of concrete pavement investigations, although it is a recognized fact that rigid type pavements are subjected to transverse stresses. This fact, together with the wide variation in the results of compressive tests on cores taken from pavements, has prompted general interest in the question as to whether the compressive test may be taken as a direct measure of the transverse strength of the pavement.

The Illinois Department of Public Works has tested a great many cores drilled from concrete pavements and in common with the experience in other States has found a wide variation to exist in the compressive strength of the cores taken from the same job. The results have been such as to suggest that the nonuniformity may be due to the conditions surrounding the test rather than variation in the quality of the concrete. If such is the case this test indicates neither the true compressive nor the flexural strength of the slab. To throw light on this point a series of laboratory tests was conducted to determine the relation between the flexural and compressive strengths of the same concrete.

Two hundred test beams were cast, 2 from each of 100 hatches and each beam was 6 by 8 by 30 inches in size. The beams were divided into three groups and one group tested at 14 days, another at 28 days and the third at 90 days. Two transverse tests were made on each beam and three compressive tests were made on cores

drilled from the sections broken in the transverse test.

The transverse strengths were determined by a method developed by the Illinois laboratory which has been found to be very satisfactory. The beams are supported as cantilevers and a wooden extension arm is secured to their free ends. At its outer end the extension arm carries a bucket, as shown in Figure 1, into which shot or water is permitted to flow from another container equipped with a quick-acting valve. Uniform application of load is thus assured, and the flexural stress at the instant of breaking can be computed by taking into account the weight of the overhanging part of the specimen and that of the extension arm as well as the weight of the bucket and the shot or water it contains. The length of the specimen and the method of mounting are such as to permit more than one test to be made on each specimen; and it is particularly interesting to note that the results of tests of the same specimen rarely vary by more than a small percentage, and that exact coincidence of results is not uncommon. Figure 2 illustrates the apparatus in use.*

An interesting comparison of the flexural and compressive tests of identical specimens is afforded by the table in which are listed the results of the two kinds of tests on 15 specimens chosen at random from the 200 beams tested. For each specimen the table shows the results of two transverse and two compressive tests and the differences between them expressed in pounds per square inch and as percentages of the minimum strength observed for each beam.

The wide variation between the compressive strengths observed for the same specimen is typical of the difference observed in tests of cores drilled from the same sections of concrete pavement. That no such difference exists in the actual strength of the concrete is clearly indicated by the remarkable consistency of the transverse tests. The location and distribution of the coarse aggregate within the core as well as the nature and size of the coarse aggregate underlying the surface doubtless affect the compressive test results; and the different moduli of

*This apparatus is now being used by a number of other laboratories including that of the Bureau of Public Roads.

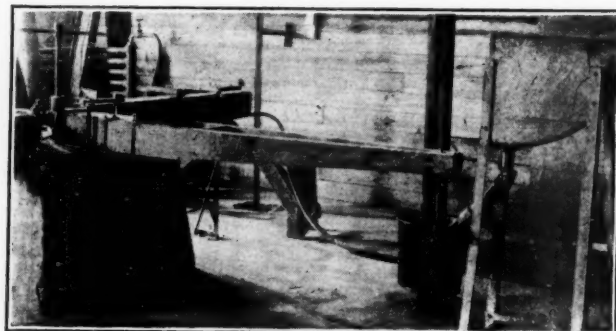


FIG. 2—VIEW OF TESTING APPARATUS USED IN DETERMINING TRANSVERSE BREAKING STRENGTH OF CONCRETE BEAMS

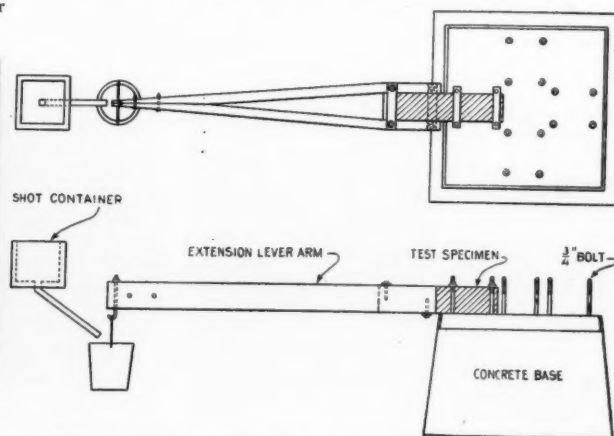


FIG. 1—PLAN AND ELEVATION OF APPARATUS

*Paper in "Public Roads," by H. F. Clemmer, formerly Engineer of Materials, Illinois Dept. of Public Works.

Comparison of transverse and compressive strength of concrete specimens

| Transverse strength | | | Compressive strength | | |
|------------------------|------------------------|----------|------------------------|------------------------|----------|
| Breaking strength | Difference in strength | | Breaking strength | Difference in strength | |
| Pounds per square inch | Pounds per square inch | Per cent | Pounds per square inch | Pounds per square inch | Per cent |
| 400..... | 2 | 0.5 | 1,008..... | 802 | 79.6 |
| 398..... | | | 1,810..... | | |
| 430..... | 17 | 0.4 | 2,000..... | 720 | 56.2 |
| 447..... | | | 1,280..... | | |
| 387..... | 11 | 0.3 | 1,352..... | 813 | 60.1 |
| 376..... | | | 2,165..... | | |
| 415..... | 24 | 5.8 | 3,520..... | 1,380 | 64.5 |
| 439..... | | | 2,140..... | | |
| 467..... | 12 | 2.6 | 3,700..... | 1,600 | 76.2 |
| 479..... | | | 2,100..... | | |
| 564..... | 13 | 2.4 | 2,610..... | 840 | 47.9 |
| 551..... | | | 1,770..... | | |
| 389..... | 36 | 10.2 | 2,530..... | 1,465 | 138.5 |
| 353..... | | | 1,065..... | | |
| 518..... | 11 | 2.0 | 2,520..... | 965 | 62.1 |
| 529..... | | | 1,555..... | | |
| 479..... | 14 | 0.3 | 2,760..... | 950 | 52.6 |
| 465..... | | | 1,610..... | | |
| 441..... | 15 | 3.4 | 2,900..... | 1,410 | 94.6 |
| 456..... | | | 1,400..... | | |
| 438..... | 20 | 5.0 | 3,040..... | 1,560 | 105.4 |
| 416..... | | | 1,480..... | | |
| 559..... | 7 | 1.3 | 2,150..... | 1,310 | 60.9 |
| 552..... | | | 3,460..... | | |
| 530..... | 4 | 0.8 | 2,005..... | 935 | 46.6 |
| 526..... | | | 2,940..... | | |
| 518..... | 23 | 5.0 | 3,400..... | 1,680 | 97.7 |
| 455..... | | | 1,720..... | | |
| 614..... | 41 | 7.2 | 4,150..... | 1,110 | 36.5 |
| 573..... | | | 3,040..... | | |
| Average..... | 3.7 | | Average..... | 72 | |

elasticity of the coarse aggregate and the surrounding mortar must also be considered, especially when the cores are tested in a universal testing machine which applies the load at a non-uniform rate.

Analysis of the results of these tests suggests several questions, among which the following seem to be of sufficient importance to warrant further investigation: (1) Does the nature and strength of the outer layer or tensile fiber control the break in the transverse test or does the whole cross section at the plane of failure control it? (2) To what extent does the relative moisture content in cylinders and beams affect the respective test results? (3) To what degree does the rate of application of the load affect the test results? (4) Does the drilling of cores with the Calyx core drill cause any structural damage to the resulting core that reveals itself in the compression test?

Mainly to provide the answers to these questions the committee on tests and investigation of the American Association of State Highway Officials has planned a series of tests to be assigned to various cooperating agencies including the Illinois highway laboratory. The tests contemplated are as follows:

1. A series of tests on drilled and cast cores of concrete in which bearing areas have been carefully prepared by the arrangement of a given number of pieces of coarse aggregate. This test is suggested by G. W. Hutchinson, former testing engineer of the North Carolina Highway Commission. It has the object of determining the effect of the distribution of aggregate on compressive strength. Tests will be varied to include many combinations of aggregates. Age variation will not be an important factor.

2. Tests to determine the effect of drilling on the strength of cores.

3. Tests to determine the distribution of fiber stress in concrete beams. This may be accomplished by testing specially constructed beams having monolithic built-up layers of various types and thicknesses of concrete.

4. Development of a compression test in which uniform application of load is obtained.

5. A series of tests to determine the effect of moisture content on both compressive and transverse strength of concrete.

Safety in Trenching

Suggestions from the experience of a California contractor. Shoring; using mechanical diggers and drag lines; back-filling around manholes; use of trench helmets.

In an address before the Construction and Allied Section of the Industrial Safety School at Los Angeles, California, George Hess, vice president of the Thomas Haverty Company of that city, made a number of suggestions, drawn largely from his own experience, for avoiding accidents in carrying on sewer construction and similar work involving excavating more or less deep trenches. Some of the more interesting of his suggestions are given below.

He had found that three by twelves placed vertically in the ditch gave the most satisfactory system of shoring for sewer trenches. The three by twelves were so placed that their bottoms rested on a firm foundation at the bottom of the trench. Instead of using wood spreaders or braces, he used regular sewer jacks with pipe extensions and large cast iron flanges so that the foot of the jack and the flange would have plenty of bearing surface. This he preferred to wooden braces because great force could be obtained by the screw feature of the jack and it eliminated the jarring and vibration which ordinarily accompanies driving wooden bracing into place. Care should be taken to see that the jacks are at right angles to the timbers and as nearly level as possible, since if placed at an angle their usefulness is more or less destroyed.

He recommends having plenty of ladders located at convenient intervals along the ditch so that in case it should begin to cave in, the men can use them without loss of time. He makes it a policy to have plenty of planks laid across the ditch to eliminate the danger of men standing directly on the edge and having this give way due to a leaky water pipe or sand pocket. Tools or materials are never dropped into the ditch but are lowered by means of a rope with a small hook attached, since braces or other obstructions in the ditch may cause deflection of the tools if dropped down, with resulting injury to the workmen below.

In using mechanical diggers he cautions the contractor not to permit men to work too close to the boom when the machine is operating and to see that the operator never starts the digging

machine until he is absolutely certain that the men are clear of the teeth and chain. On one of his jobs a workman slipped and fell onto the revolving chain, but the operator was watchful and had the chain stopped before the man actually hit it. Otherwise he would have been ground to death.

"When excavating with drag lines, be very careful to keep the boom and cables away from overhead power wires. It is best to cover the boom with wood lagging if there is any danger of striking the power wires.

"It is very dangerous to dump a drag line bucket directly into a dump truck or small car if the driver is sitting on the truck, as an operator can not control a drag line bucket quite as effectively as a steam shovel operator can his dipper.

"The conveyor on the side of a digging machine is generally a dangerous thing because sometimes a driver of an automobile will have the top of his machine taken off by striking one of these conveyors."

He cautions against digging too close to existing sewers, which might have leaky joints and thus cause the caving in of the earth between the new trench and the old sewer. Also, care should be taken when paralleling sewer, water, or gas mains or a curb to prevent this falling into the ditch and injuring the men below, and the same is true of telegraph or telephone poles.

Another source of danger is the collapsing of manholes during backfilling. If the trench has been filled with water for puddling the backfill, the collapsing manhole may allow it to run down the sewer and damage the work below or possibly drown workmen inside the sewer. In filling around the manhole, place dirt on all sides of it so that the pressure against it will be uniform around the circumference.

When digging in gravel formations where there are large gravel stones or small boulders which occasionally drop on the men below, he supplied the workmen with steel trench helmets which might prevent serious injury to the men's skulls.

"I cannot recall a serious accident in any ditch where conditions were really bad. We have been in mud, quicksand, peat, rock and clay, but our men, realizing that it was dangerous, took extra precautions. But our greatest number of accidents have been in ground that looked safe and they took a chance."

Toledo Street Department Activities

In the report for the year 1925 of the street department of Toledo, Ohio, the statement is made that "street cleaning is now considered one of the most important municipal activities." In this class of work the department still uses both horse-drawn vehicles and hand sweeping as well as motor-drawn apparatus. The hand patrol last year cleaned 4,595 miles of streets, chiefly in the business district. An average of 25 men were employed in this service. The horse-drawn vehicles were operated with four crews, each with 8 men, shovels and brushes being

used to supplement the mechanical cleaning. These cleaned 2,819 miles of streets. The department operated three motor-drawn pick-up sweepers with crews of three men each, which cleaned a total of 3,991 miles.

Each street in the city received from 20 to 45 cleanings during the year. A total of 26,508 loads of dirt and rubbish were removed. In sprinkling the streets, 269,998 gallons of water were used. The department removed 6,647 loads of snow from the streets in the congested area of the city. The total amount spent for street cleaning was \$272,370 of which \$211,075 was for labor. The funds for this are secured by assessing the property owners along the streets cleaned, the city being divided into ten districts for this purpose. All property owners in any one district pay the same rate, which varied last year from six cents per foot front in one of the residential districts to \$1.19 in the downtown district.

The department also repairs streets and last year repaired 73,789 square yards of brick, stone, macadam, asphalt block, kreolite and wood block pavements. It built and repaved 166,560 sq. yds. of cinder roads, laid 120,751 sq. yds. of cold tar patching, scraped and turnpiked 378 miles and did other miscellaneous work.

Garbage also is collected by the department, 16,847 loads having been collected last year from residences, hotels and restaurants; which amount is estimated to weigh 35,693 tons.

In performing this service, the department uses its own equipment consisting of 30 teams and wagons and 6 one-ton Ford dump trucks. An average of 60 men were employed in the collection service and the total cost for the year was \$111,891. Most of the garbage is turned over to the Pan-American Feed and Milling Company, to which the city paid \$13,766 for disposing of the garbage. Any that can not be utilized by the company is hauled to farms and plowed under.

Catchbasins, inlets and sewers were cleaned by the department, for which purpose it employed a motor-driven sewer eductor with a crew of three men, and two crews of three men each with hand cleaning equipment.

New York State Public Works Department

The New York State Legislature has passed a bill, effective January 1, 1927, creating a state Department of Public Works, headed by a superintendent of public works to be appointed by the governor at an annual salary of \$12,000.

To this department there are assigned all of the functions, powers, duties, etc., of the present Department of Public Works, the State Engineer and Surveyor, the Department of Architecture and the State Architect, the Bureau and Commission of Housing and Regional Planning, the Bureau and Commission of Fine Arts, the Canal Board, the Salt Water Bays Commission, and the office of Harbor Master, to be exercised and performed through the following divisions:

1. Division of Canals and Waterways, in lieu of the Bureau of Canals.

2. Division of Highways, in lieu of the Bureau of Highways.

3. Division of Public Buildings, in lieu of the Bureau of Public Buildings.

4. Division of Engineering, headed by the State Engineer. This division will exercise the powers and perform the duties now vested in the State Engineer and Surveyor.

5. Division of Architecture, headed by the State Architect, which shall exercise the powers and perform the duties now vested in the Department of Architecture and the State Architect. In this division there shall be a Bureau of Housing and Regional Planning and a Bureau of Fine Arts.

The heads of each of these five divisions are to be appointed by the Superintendent of Public Works and receive salaries to be fixed by him.

The Act abolishes the existing Department of Architecture, the Salt Water Bays Commission, and the Office of Harbor Master.

Reorganizing New Bedford Street Department

During the year of 1925, the street department of the city of New Bedford, Massachusetts, which maintains not only the streets but also the sewers and bridges, was reorganized by W. P. Hammersley, superintendent of streets, with a resulting saving in cost and increase in efficiency. This was due partly to the organization of the business of the department and partly to the increased efficiency in actual performance of work.

Formerly there had been no adequate method or system for ordering and purchasing supplies and materials or for checking receipts and disbursements. A system was devised whereby every transaction from the original requisition to final disposition is recorded, conveniently filed and available for inspection at any time. Also the practice was adopted of recording the needs of the department and securing competitive prices before placing purchase orders, resulting in lower prices and the fact that no excessive stocks have been carried on hand. Mr. Hammersley reports that approximately \$120,000 less was expended last year for supplies and materials than in the preceding year although considerably more work was accomplished; the total expenditures in 1925 having been \$1,555,097 and the saving therefore having been nearly eight per cent.

Examination of the accounts of the department disclosed that a large number of bills were outstanding for work performed by the city without any serious attempt having been made to collect them, several of them (totaling about \$3,000) having already been lost through the statute of limitations. All bills are now submitted to the tax collector monthly for collection.

A method of time keeping and cost accounting has been inaugurated whereby all labor charges are entered against each item of work, together with those for materials and supplies, and each job

account is so kept that its cost can be ascertained at any stage in its construction.

Construction equipment was found to be dilapidated to such an extent that some of it was not considered worth while repairing, especially some of the automobiles and trucks. Equipment which was too badly worn to pay for repairing was disposed of at public auction. Machinery worth repairing was thoroughly overhauled and put into service. A cable machine used on sewer work had not been used by the city for years but had been rented to a local contractor for five dollars a week, which would not pay for the ordinary wear on the machine. This is now being used by the city. The department owns seven steam road rollers, which were found to be in fair condition. A Barber-Greene loader and portable air compressors are used by the city and have proved to be worthwhile labor-saving devices. Three mechanical stone spreaders were purchased early in the year and did the work of at least nine men spreading stone by the old hand method. An asphalt plant purchased in 1915 had been partly dismantled and had not been used for a number of years and the superintendent recommended that a modern plant be purchased as a safeguard in case the contractor owning the only plant in the locality should decide to remove it.

A change was made in the method of making joints in sewer pipes, the city now using a bituminous compound instead of the old cement joints. He recommends the purchase of a pneumatic hammer for driving sheeting and is considering the advisability of using steel sheet piling whenever water and fine sand are encountered. He also recommends the purchase of another catch basin cleaner.

Concrete Road Construction in Tennessee

Especial effort has been made by the Tennessee State Highway Department to secure the best result possible in constructing State Highway No. 1, the principal through route crossing the state from the Virginia state highway in the northeast corner to Memphis in the southwest. Much of the distance has already been paved and it is expected that no earth road sections will be left at the end of this year.

Last season an 18-foot concrete section was built south of Brownsville, that in Haywood County by J. E. Pryor & Co. of Martin and that in Tipton County by S. K. Jones & Co. of Memphis. According to O. H. Hausard, engineer of the highway department, especial attention was paid to longitudinal float, operated by two men. It was used first as a tamp, then as a float which wiped out any uneven places left by the strike and tamp templates of the finishing machine. The men who handled the float tried the surface with a straightedge before they moved their bridges ahead.

Following the longitudinal float, two men further smoothed the surface with long-handled floats. Each of these men had a straightedge

with which he tried the surface before leaving it.

As soon as the concrete had become hard enough the inspector checked the surface with a straightedge and marked any high spots. These were removed by polishing with a carborundum stone, the polisher working until his straight-edge showed a true surface.

Hiring Vehicles for Refuse Collection

Sixteen large cities furnish information on the subject of rates paid, capacities, requirements, etc. Several seldom if ever hire any vehicles

At the request of one of the aldermen of Chicago, Frederick Rex, municipal reference librarian of the city, obtained information concerning the "cost of motor truck and team hire in cities in the collection of garbage, ashes and miscellaneous refuse"; which information he has kindly furnished to us. The substance of it is given below.

The information asked for was furnished by Baltimore, Boston, Buffalo, Cincinnati, Cleveland, Indianapolis, Jersey City, Los Angeles, Milwaukee, Minneapolis, New York, Philadelphia, Rochester, St. Louis, Seattle, and Washington.

Of these, no vehicles are hired by Cincinnati (garbage collection by contract), Indianapolis, Minneapolis, St. Louis, or Washington. In Minneapolis, however, a municipal bureau controls all "major portable equipment" and bills each division for the vehicles used by it, as described further in this article. In several of the cities vehicles are hired only at times when the demands exceed the capacity of the municipally owned vehicles.

In Baltimore the commissioner of street cleaning hires only about ten motor trucks, capacity 6 cu. yds. of garbage or ashes or 7 cu. yds. of refuse, paying \$2 per hour.

In Boston the Sewer and Sanitary Division, Public Works Department, let a contract January 1st for furnishing double and single teams and auto trucks, with respective capacities of 4 1-2 cu. yds., 2 1-2 cu. yds., and 10 cu. yds. at the following rates:

| Rates for Hiring Vehicles by Contract in Boston | | | | | | |
|---|--------------|--------|--------------|--------|-------------|------------------------|
| Dist | Double Teams | | Single Teams | | Autos | |
| | No. of Days | Rate | No. of Days | Rate | No. of Days | Rate |
| No. 1 | 900 | \$6.75 | 300 | \$3.90 | 200 | \$23.00 |
| No. 2 | 100 | 8.00 | 20 | 6.00 | 10 | 23.00 |
| No. 3 | 20 | 8.00 | 20 | 6.00 | 25 | 23.00 |
| No. 5 | 1,000 | 5.50 | 25 | 3.00 | 250 | 23.00 |
| No. 6-9 | 400 | 7.50 | 20 | 4.00 | 80 | 23.00 |
| No. 7 | 1,000 | 4.98 | 50 | 3.00 | 700 | 23.00 |
| No. 8 | 1,100 | 7.75 | 700 | 6.00 | 300 | 23.00 |
| No. 10 | 700 | 7.10 | 2,500 | 6.10 | 100 | 23.00 |
| No. 11 | 50 | 8.00 | 10 | 6.00 | 50 | 23.00 |
| | | | | | | Contractor |
| | | | | | | Edw. J. Byrne |
| | | | | | | E. J. McHugh & Son |
| | | | | | | E. J. McHugh & Son |
| | | | | | | M. Doyle & Co., Inc. |
| | | | | | | Charles Loonie |
| | | | | | | M. McGinnis & Co. |
| | | | | | | M. H. Loonie Cons. Co. |
| | | | | | | B. E. Grant Co. |
| | | | | | | T. H. Corrigan & Sons |

Buffalo does not hire teams or trucks for ash or refuse removal but does hire them for snow removal, paying \$2.50 per hour for 5-ton 7-yard dump trucks and \$1 per hour for 3-yard dump wagons.

Cleveland owns all trucks used but hires teams for ash and rubbish collection, paying \$1 per hour for 2½-yard wagons; the total last year being \$115,000.

Jersey City contracts collection of "ashes, garbage and kitchen refuse," but has hired a few motor trucks at \$25 a day.

Los Angeles hires no teams or trucks for garbage collection, but teams hired for other work cost \$8.25 a day, and 2½-ton trucks \$276.50 a month. Drivers are allowed all legal holidays, two weeks' vacation each year and one-half day off each Saturday, receiving 312 days' pay for 260 days.

New York City. The boroughs of Manhattan, Brooklyn and Bronx have not hired trucks or teams for eight years past, except for six weeks this year for snow removal, when they paid \$22.50, \$25 and \$30, according to the distance required, an average load being 8 yards and 4 to 6 loads per day being required.

In Queens Borough the Board of Estimate and Apportionment allows the following rates:

3½ to 5 ton motor truck, carrying 6 cu. yards of garbage, ashes or sweepings, and 16 cu. yards of refuse, per day of 8 hrs., \$25.00.

Motor trucks over 2 and less than 3½ tons, carrying not less than 4 cu. yards of ashes, garbage and sweepings, and not less than 12 cu. yards of refuse, per day of 8 hours, \$17.50.

Horse and cart with driver and vehicle, per day of 8 hours, \$6.00.

Team and truck with driver and vehicle, per day of 8 hours, \$8.00.

"The team and vehicle carries 3 yards of ashes, garbage or sweepings, and 9 to 10 yards of refuse. Horse and cart, 2 cu. yards of ashes, garbage or sweepings, and 9 to 10 yards of refuse. Horse and cart, 2 cu. yards of ashes, garbage or sweepings, and 7 cu. yards of refuse.

"I would not call these a prevailing rate of wages, but one which is fixed by our Board of Estimate and Apportionment. The fixation of this rate is positive, and no higher can be paid except by special resolution of the Board.

In Philadelphia 5-ton motor trucks "may be hired at the rate of \$2.50 per hour, and two-horse drop-bottom wagons may be hired for \$1.00 per hour; the price includes the driver," says A. M. Soby, chief of the Bureau of Street Cleaning.

In Rochester the department pays \$2.50 per hour

for five-ton dump trucks and \$7.50 per day for team with dump wagon.

In Seattle what few trucks are hired by the Department of Streets and Sewers are paid for at the uni-

form rate of \$3.50 per hour for a 5-ton truck, which includes fuel, oil and driver.

COST OF MUNICIPAL COLLECTION

In addition to the above, several cities gave information concerning the cost and methods of municipal collection and disposal, from which the following quotations are made:

Indianapolis—According to Russell T. MacFall, vice-president of the Board of Sanitary Commissioners of the Sanitary District of Indianapolis, in a letter dated May 27, 1926:

This collection is made by this department and not by private collectors. We own a fleet of reversible side-dump trailers, hauling four tons of garbage each. These are loaded in the streets and alleys, horse drawn and attended by one man, usually the owner of the team. When loaded, they are assembled at a common rendezvous, made up into trains of four and hauled by tractor-truck to the reduction plant, an average haul of five miles.

The ashes are collected in the same way except that the driver and helper load the trailers, which are assembled and made up into trains and hauled to the dumps, with an average haul of about two miles.

The average cost of collecting and hauling garbage for 1925 was \$3.105 a ton. The cost of collecting ashes for 1925 was \$.665 per yard, and collecting market house refuse, \$.442 per yard. Last year we collected and disposed of a little over 25,000 tons of garbage with a net profit to the reduction plant of about \$21,000.

Jersey City—Said Edward B. See, chief clerk of the Department of Streets and Public Improvements: "We have no incinerator plant of the city, the ashes and garbage and kitchen refuse are collected and taken to the lowlands and dumped. The contractor under his contract must cover it with a layer of earth. He is also required to comply with all the rules and regulations of the Health Department."

In Los Angeles, according to C. E. Nash, cost accountant in the Engineering Department. "Garbage collectors are paid \$4.75 per day for day service and \$5.00 per day for night service. The garbage is collected by the city and delivered to a central loading station where it is loaded aboard car and shipped to a hog feeding ranch about 70 miles from the city. The rubbish is dumped on low lots, usually private property."

Milwaukee—As stated above, in Milwaukee a municipal bureau controls the vehicular equipment. Concerning this Frederick N. MacMillin, municipal reference librarian, stated:

All of the major portable equipment of the city of Milwaukee, with certain exceptions, is under the control of the recently created Bureau of Municipal Equipment of the Department of Public Works, and the various divisions of the departments of the city government are billed by this bureau for vehicles used by them. In this way, for example, the trucks and trailers used for hauling garbage are also used by other divisions for other purposes.

The year 1925 was the second year of operation of the Bureau of Municipal Equipment, and the following schedule of rates was enforced during the year:

Schedule of Rates on Use of Equipment

| Type of Equipment | Rate Hourly | Mileage |
|---|-------------|---------|
| Autos | 10 c | |
| Ford Rdstr. | | .08 |
| Ford Touring | | .09 |
| Other passenger cars except one below | | .10 |
| Big touring and sedan | | .12 |

| | | |
|------------------------------|--|------|
| Light Trucks | 10 c | .. |
| Rdstr. type | | .11 |
| Touring type | | .11 |
| One ton | | .12 |
| 1½ and 2 ton | | .14 |
| Heavy Trucks | | None |
| 3½ ton | 50 c | .. |
| 5 ton | 80 c | .. |
| Other Equipment | | None |
| Trailers, Sanitation | 6¼c | .. |
| Trailers, Stone | 9 c | .. |
| Trailers, No. 0 | 12½c | .. |
| Road rollers | 1.70 | .. |
| Concrete mixers | 1.50 | .. |
| Air compressors | 1.50 | .. |
| Tractors, Cater | 1.20 | .. |
| Tractors, light | .80 | .. |
| Sweepers, Motor driven | .90 | .. |
| Educators | .90 | .. |
| Flushers, Motor driven | 1.00 | .. |
| Sprinklers, Horse drawn | Operative & Repair Costs Plus Overhead | |
| Flushers, Horse drawn | | |
| Snow loaders | | |
| Pumps, Hoists, etc. | | |
| Derrick | 25 c | .. |

All rates are exclusive of operator.

(In the case of all light equipment up to and including two-ton trucks, it has been found that a combined mileage and hourly rate is most suitable to prevent the allowing of equipment to stand idle without reporting same available.)

New York City, Borough of Queens—Carl Gerks, superintendent of the Bureau of Street Cleaning, said: "In the Borough of Queens we have two methods of final disposition—by incineration and inland dumps. At the present time we are operating eight Decarie incinerators, a total tonnage of 890 per day. Moneys have been approved for two additional plants of 150 tons each; also for two additional sites, money for which will be allotted in 1927. On the inland dumps, ashes and mixed material are deposited. The better grade of ashes are used on dirt streets and to cover the poorer mixture of mixed material in order to make same as sanitary as possible. The residue from incinerators is used for covering on inland dumps, as well as on dirt streets."

"The city of St. Louis," said J. M. Slater, commissioner of the Department of Streets and Sewers, "owns all the equipment employed in the collection of household garbage. We have in service at the present time approximately 100 two-horse drawn garbage collection wagons. The number of wagons employed in this work fluctuates according to the volume of garbage collected. During the winter months when this is at the minimum, between seventy-five and ninety wagons are all that are necessary, and during the peak period—July, August and September—as many as 140 wagons are so employed."

"The compensation for the driver is \$115 per month and the keep of our animals is approximately \$1.00 per head per day."

"The garbage is collected three times each week in any given part of the city and loaded on barges at the river. These barges are the property of a private contractor, who has a contract with the city for the disposal, for which he is paid at the rate of 74c per ton. This garbage is then taken down the river approximately fifty miles and deposited on an island, where it is fed to hogs."

"At the present time motor trucks have not been put in service in this work in this city, although we have four tractors and twenty-four trailers, which it is intended to put in service as soon as a proper unloading platform is erected."

"During the past year there was collected 68,246 tons of garbage; 63,976 tons were delivered to the barges, and 4,270 tons were received by private hog raisers, who have such farms in various parts of the country within a few miles of the city."

"The cost of collection for garbage for the year ending April 1, 1926 was \$4.33 per ton, together with the disposal at 74c per ton, amounts to \$5.07 per ton for the collection and disposal.

"There was also collected during that fiscal year 1,354 dead animals, such as horses, cows and other large animals, and 16,872 small animals, such as dogs, etc. The cost of collecting these amounted to \$5,994. Motor trucks are employed in the collection of dead animals, which animals are delivered to a private rendering company for disposal.

"Ashes and other household rubbish are not collected by the city. This must be disposed of by the individual citizens and at their own expense."

Strength of Culvert Pipes

The supporting strength of culvert pipes has been investigated by means of an actual experiment by the Iowa Engineering Experiment Station of Iowa State College, in co-operation with the U. S. Bureau of Public Roads. The research was conducted under the guidance of dean Anston Marston. The result of this, which is termed a "preliminary experiment," has just been published.

The experiment described in this bulletin is the first of a number planned by the Experiment Station to determine, for different kinds of culvert pipe, embanking materials and field conditions, the ratios between the supporting strengths which culvert pipe can safely be counted upon to develop in actual use and the laboratory strengths of such pipe when tested by standard methods.

In this experiment, 10 sections, each 23.5 inches long, of practically unreinforced 36-inch concrete culvert pipe with shells 3 inches thick, were tested in an embankment which was built up gradually to a height of 10 feet above the top of the pipe. This culvert was constructed on the site of a previous experimental pipe culvert, the loads imposed upon which, by the embankment, were actually weighed for each height of fill, thus making it possible to estimate closely the supporting strengths developed by the pipes in this experiment.

Measurements of side pressures were made in this experiment by the use of six earth pressure cells.

Laboratory tests with three-edged bearings were made of five pipe like those put into the test culvert.

The culvert pipes in this experiment cracked under heights of embankment ranging from 4 to 8.5 feet above the top of the culvert, but none of the pipes collapsed or deformed extensively under the loads imposed by an embankment 10 feet high above the top of the culvert.

Measurements of settlements and deformation of the pipes showed that the settlement of the rigid culvert pipes used was many times greater than any lowering of their tops from shortening of their vertical diameters under the loads.

The ratio of actual supporting strength to three-edge bearing laboratory test strength was approximately 2.6 at first crack in this experiment. Without the help of the active side pressure the ratio would have been about 1.9.

The measurements of side pressure by earth pressure cells varied widely, showing a range equal to 158 percent of the smallest result, but in a general way the result confirmed the conclusion, reached long since by the Iowa Engineering Experiment Station, that the active horizontal pressure in a mass of granular materials can be computed with fair accuracy by Rankine's formula for horizontal earth pressures.

The investigators state, however, that the experiment reported in this bulletin is not alone sufficient to warrant drawing general conclusions as to the safe ratio between the field supporting strengths and the laboratory test strengths of culvert pipe."

Patching Concrete Pavements

The method of patching concrete pavements employed in Lewistown, Manheim and other Pennsylvania cities which has proved very satisfactory, is described in "Concrete Highway Magazine," by Geo. D. C. Danner, consulting engineer, as follows:

"The edges of the cut should be trimmed down square with the surface, or even recessed about an inch at the center of the pavement slab, to permit the patch to dovetail into the pavement. The trench must be thoroughly settled, flushed and tamped before replacing the concrete. The mix for the patch is the same as for the original pavement, using clean materials, thoroughly mixed. All materials should be the same color as those in the original pavement, for the best results. Keep the concrete very dry and tamp it solidly in place in layers. Good tamping, careful striking off and floating the surface, with thorough wet curing result in a patch blending almost perfectly with the surrounding pavement. It is good practice to place ¼-inch reinforcing bars in the patch, spaced 6 by 12 inches, center to center.

"Resurfacing a concrete base or pavement only carries this process a step farther. The surface of the old concrete is thoroughly cleaned, roughened if necessary and wet down before the new concrete is placed on top."

A patch made in this way in 1919 for installing a fire hydrant is today hardly discernible.

"In 1915, by accident, one low spot about 30 feet long, was left in the pavement surface, running from the curb to the center. It was the only blemish in an otherwise perfect pavement. In 1916, this was resurfaced by borough forces under the direction of the writer. The old concrete was thoroughly cleaned and slightly roughened and the new concrete tamped in place. The maximum thickness of new concrete at the center of the patch is ¾ of an inch, from which it runs out to a feather-edge fifteen feet away in each direction. Under ten years of continuous, heavy traffic passing through Manheim, no cracking or scaling has occurred and today it is almost impossible to distinguish the location of this resurfacing."

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CONTENTS

| | |
|--|-----|
| NEW WASHINGTON FILTER PLANT. Illustrated | 197 |
| Studying Boston Garbage Disposal..... | 202 |
| GARBAGE DISPOSAL IN CLEVELAND. Illustrated. By C. C. Smith..... | 203 |
| TRANSVERSE TESTS OF CONCRETE. Illustrated | 204 |
| SAFETY IN TRENCHING | 205 |
| Toledo Street Department Activities..... | 206 |
| New York State Public Works Department..... | 206 |
| REORGANIZING NEW BEDFORD STREET DEPARTMENT | 207 |
| Concrete Road Construction in Tennessee..... | 207 |
| HIRING VEHICLES FOR REFUSE COLLECTION | 208 |
| Strength of Culvert Pipes | 210 |
| Patching Concrete Pavements..... | 210 |
| EDITORIAL NOTES | 211 |
| Assessing Corner Lots—Legal Responsibility for Typhoid | |
| AMERICAN WATER WORKS CONVENTION... | 212 |
| SEWAGE TREATMENT IN CHICAGO. Illustrated | 218 |
| NEW YORK'S EXPERIENCES WITH COPPER SULPHATE. Illustrated. By Frank E. Hale.... | 221 |
| TWO-MAIN SYSTEM OF DISTRIBUTION. Illustrated | 222 |
| ASSESSMENT OF CORNER LOTS. By John Simpson | 223 |
| COUNTY HIGHWAY PAVING STATISTICS. Tables. | |
| County Highway Appropriations..... | 226 |
| Cement Concrete Paving in 1925 | 228 |
| Gravel Roads in 1925..... | 229 |
| Sand-Clay Roads in 1925..... | 229 |
| Top Soil in 1925..... | 229 |
| Graded Roads Constructed in 1925..... | 229 |
| Waterbound Macadam in 1925..... | 230 |
| Brick Pavement Laid in 1925..... | 230 |
| Bituminous Concrete laid in 1925..... | 230 |
| Bituminous Macadam Laid in 1925..... | 230 |
| RECENT LEGAL DECISIONS..... | 231 |

Assessing Corner Lots

If we may judge from letters received from the readers of PUBLIC WORKS, the "Recent Legal Decisions," which have been a regular feature of this paper for several years past, are appreciated by them fully as much as any other one class of information which we publish. These brief abstracts of individual decisions have occasionally been supplemented by summaries of decisions rendered by many courts on the various phases of a given subject, such as "Obstructions in Streets and Roads," and "Charges for Private Fire Protection." This month we present a summary of decisions relative to municipal ordinances calling for assessment of cost of paving, sewers, etc., upon both sides of corner lots.

The courts seem to agree that, where ordinances require assessment of costs, presumed to be apportioned to the several abutting properties in proportion to benefits received, these benefits are in direct proportion to the lineal feet of frontage the lot may have on any or all streets. This is only one more of the absurdities and injustices to which legal reasoning sometimes leads; in this case apparently because deduced from the false premise that all the benefit derived from paving or sewerage accrues to the abutting property. Of which more next month.

Legal Responsibility for Typhoid

A new aspect of the subject of maintaining the purity of public water supplies was brought out several times during discussions at the recent convention of the American Water Works Association. This is the legal responsibility of a company or city for sickness or death from typhoid or other disease resulting from carelessness or worse in delivering polluted water to consumers. A western court has decided that incurring typhoid by drinking from a public water supply is not an "act of God," but comes under the head of an "accident" for which those delivering the water may be sued.

It may be assumed that the city or company may free itself of legal responsibility by proving that it has taken every reasonable precaution against pollution of the water. What is "reasonable precaution" must be decided in the light of the latest confirmed knowledge and approved methods. It of course includes analyses of the water and examination of the water shed made at more or less frequent intervals, and as a minimum precaution in case of water possible of pollution, treatment with chlorine or other approved disinfectant. Criminal carelessness might be claimed if the chlorinating plant, getting out of order, should be allowed to remain inoperative or inefficient; or if, the regular supply becoming inadequate, a supplementary supply be obtained from a source of doubtful safety without treatment calculated to render it safe.

Responsibility generally carries with it liability for damages, and in the case of a typhoid epidemic these might mount to very large figures—even to the total value of the water works. To what extent a municipality may successfully claim exemption under the plea that its operation of the plant was the exercise of a govern-

mental function may vary in different states, but to private companies, at least, no such escape from payment of damages is open, and it is doubtful if there are many states where such escape to cities also would not be closed.

There would seem to be an opening here for a new kind of accident insurance; and, with such an insurance company operating, for a source of continuous revenue for investigation of purification methods and watchfulness of operating plants, somewhat analogous to the National Board of Fire Underwriters' Committee on Fire Prevention and Engineering Standards.

The great majority of water works engineers and superintendents need no threat of resulting penalty to keep them ever mindful of their responsibility to their consumers and diligent in safeguarding the purity of the water. There are, however, a few ignorant or careless individuals who should be removed from charge of water systems; and many municipal officials who refuse to give to their water superintendents the power or money for installing, operating, and maintaining at adequate capacity the precautionary measures which the latter recommend.

American Water Works Convention

Business doings and professional papers and discussions at the forty-sixth annual convention of the American Water Works Association. About a thousand in attendance. Important business transacted. Interesting discussion of papers.

The forty-sixth annual convention of the American Water Works Association, held at Buffalo, N. Y., June 7th to 11th, appeared to us to be the most successful that we have attended. Nearly six hundred active members and about 270 associate members were registered, in addition to guests. Equally important, at practically every meeting most of the seats were filled, although there were ten technical sessions, several divided into two and one into three sections. Perhaps most significant of the earnestness in obtaining practical benefit from the convention that was displayed was the fact that the get-together meeting for informal discussions, which was held on Monday before the formal opening of the convention, was attended by about two hundred and the interest was so great that the entire time available was consumed in the discussion of three of the seven topics and consideration of the other four was postponed until Wednesday.

The Executive Committee announced that it had selected Chicago for the 1927 Convention; also that it recommended for honorary membership in the association George G. Earl, Robert J. Thomas, James L. Tighe and Col. R. M. Clayton, which was adopted by vote of the convention.

It also submitted a proposal to increase the dues of active members from \$7 to \$10, of corporate members to \$15, and of associate members to \$25, which was unanimously adopted. This will permit financing a budget of \$42,000 instead of \$36,000 and employing Beekman C. Little as full-time secretary. During the past fiscal year the expenditures exceeded the income by a little over \$2,000.

Two new sections were authorized, a Montana section and a Rocky Mountain Section. Districts No. 4 and No. 5 were changed by taking District of Columbia and Maryland from No. 5 and adding them to No. 4.

The officials for 1926-1927 were announced as follows: President, Allan W. Cuddeback; vice-president, James E. Gibson; treasurer, William W. Brush; trustee Dist. 3, Fred E. Beck; trustee Dist. 5, J. O. Craig; trustee Dist. 7, Theodore A. Leisen.

The several districts elected as nominating committee J. Clark Keith, Patrick Gear, Wm. A. McCaffrey, G. C. Gensheimer, W. E. Vest, A. B. Morrill, H. E. Keeler and Harry N. Jenks; and these met and presented as nominees for 1927-1928 James E. Gibson for president, Wm. W. Brush for vice-president, Geo. C. Gensheimer for treasurer, Seth M. Van Loan for trustee of Dist. 2 and L. R. Howson for trustee of Dist. 8. Nomination for trustee of Dist. 9 will be announced later.

The Executive Committee announced a policy for selecting future convention cities. The convention committee of the society and that of the Manufacturers' Association were asked to find out what cities have facilities for taking care of conventions of the society, including at least 10,000 square feet of exhibit space and adequate audience rooms in the same hotel, good railroad facilities and so located as to be easily accessible for members and prospective members; cities to be selected in each of the society's nine districts which would be acceptable.

The first award of the J. M. Diven Memorial ("to the active member who during the year has best served the association") was made to George W. Fuller in recognition of his work as chairman of the Standardization Council, particularly in the preparation of the "Manual."

The Hill cup to the section that obtained the greatest percentage increase in membership during the previous year, again went to California, with a 30 per cent increase.

Several of the more prominent members of the society have, during the past few months,

lost their positions as heads of water departments, and it was presumably with reference to this that the executive committee presented and the convention adopted a resolution condemning interference with water departments by municipal officials for personal or partisan reasons.

The exhibit was a quite complete presentation of materials and equipment used by water works and the general appearance of the large room was unusually attractive. A list of the exhibitors was given in PUBLIC WORKS last month. The registration desk was at one side of the exhibit hall—an excellent arrangement which gave publicity to the exhibits without permitting noise and talk from them to interfere with the meetings, which were held on the floor above; interference which has been very annoying at conventions of several societies in recent years.

NARRATIVE OF THE CONVENTION

On Monday afternoon an Experience Meeting with about 200 present discussed three of the seven topics on the program, namely: "Periodic vs. Continuous Readings and Billing for Water Companies and Departments"; "Diversion of the Funds of the Municipally Owned and Operated Water Plant to Use of Other Departments of the Municipality"; and "Use of Pulverized Fuel in the Water Works Plant". The discussion of each of these was opened by members who had prepared beforehand facts and ideas based upon their own experience, the third of these papers being illustrated by lantern slides. (This discussion will appear in a later issue of PUBLIC WORKS.) The other four papers were postponed until opportunity could be found for them at a later date and were taken up on Wednesday as will be described later.

On Tuesday, shortly after nine A. M., the convention was formally opened with a prayer for members who had died during the year, followed by an address of welcome by one of the city commissioners. The secretary announced a net gain of membership during the year up to December 31st, 1925 of 57; but owing to a change in the end of the fiscal year this included losses incurred by dropping members at two consecutive conventions. If the loss of this kind at one convention only were included, a net gain of about 150 would have been shown.

The Executive Committee reported several matters which have already been referred to and the convention at this time voted on the increase in dues suggested and the adoption of a budget.

W. W. Brush read the report of the committee on Standard Specifications for Water Meters. Practically nothing remained for the committee to consider except standardization of dials and it recommended that nothing further be done toward attempting such standardization as several of the larger companies said that they would not change to a standard were one adopted, since they would have to continue to provide to the larger cities the types of dials which are at present in use and the standard would probably be simply an additional model that they would have to carry in stock. It was suggested, how-

ever, that it might be found desirable to adopt a straight reading dial as standard.

The committee on Standard Brass Fittings reported progress and expectation of having a schedule for the next convention. The committee on Standard Form of Contract did not think that much remained for it to do but had been closely watching the reception of the form it had adopted with a view to possible improvements.

George W. Fuller, reporting for the Standardization Council, said that about 2,500 copies of the "manual" had been sold and that arrangement had been made for a second printing of about 1,500 in a few weeks; and asked members to send to the council at once any suggestions as to typographical or other minor changes. He also desired that members individually and in the local sections consider revisions to the manual to be made when a new edition shall be published, probably within the next year or two. He stated that the "Standard Methods of Analysis" also was selling well.

Under the head of "New Business" there was a brief discussion of the present status of the income tax as applied to employes of water departments, those who have looked into the matter apparently agreeing that the federal agents themselves differed widely in their interpretation of the regulations on these points.

Concerning the committee on Boiler Feed Water Studies, it was reported that this committee had been remarkably active during the year, that nine sub-committees had been appointed and that the subject was to be considered this fall at the convention of the Society of Mechanical Engineers in New York City.

The session concluded with a talk on the Buffalo waterworks by George C. Andrews, commissioner, who illustrated it by views of the plant, map of the city, etc.

The afternoon was opened with a paper on "Universal Metering" by John Ericson, in which he touched upon the history of metering in Chicago and the reasons why metering was unquestionably desirable. George W. Booth, in a paper entitled "Co-ordination of Fire Fighting Facilities" urged the cordial co-operation of water and fire departments in every municipality.

"Securing Improved Technical Supervision of Water Purification Processes" was the subject of a paper by H. E. Miller of the State Board of Health of North Carolina, in which he referred to the excellent showing made by the North Carolina section of the American Waterworks Association and stated that such local sections were most valuable means of improving the operation of waterworks in small towns. In his state, as each purification plant goes into service, a representative of the state health board is assigned to supervise it and instruct the operator. He gives his undivided attention to this plant for ten days or more and later visits it at intervals of seven days or less, a schedule being made out for each representative of the board providing for periodic visits to all plants within his district.

Plant operators have been much encouraged by recent advancement of several operators from small to larger towns, in each case with an advance of salary. H. E. Moses of the Pennsylvania department of health stated that the 175 plants in his state made quite a problem for the board of health and recommended that the state adopt regulations requiring that each new plant be operated for at least six months under the control of the designer, this being made a part of the contract for the design. W. C. Hawley, thought that the salaries paid in the state by the smaller places, \$1,500 to \$2,000, were too small to encourage competent men to become operators. Another member suggested the employment of an operator by several small towns jointly, as had been done in Ohio.

The "Use of Standpipes and Elevated Tanks to Reinforce the Distribution System During Periods of High Demand" was explained by Nicholas S. Hill, Jr., who stated that in some cases a comparatively small amount spent in constructing a standpipe or tank for this purpose might secure as good results as much greater amounts devoted to laying larger mains. In the discussion several members told of having followed the ideas explained by Mr. Hill and the discussion led to one on the use of overflows, altitude valves and other features of tanks and stand pipes.

WEDNESDAY'S SESSIONS

Wednesday morning's session opened with a paper by Prof. A. N. Talbot, entitled "Strength of Cast Iron Pipe Manufactured in Various Ways", which W. W. Brush believed to be the most important which had been presented on the subject of water pipe for several years. In this paper (an abstract of which will appear in *PUBLIC WORKS* later), Prof. Talbot gave the result of tests made on sand cast, sand spun and De-Lavaud pipe, several of each of which were subjected to internal pressure, cross bending and impact; while other tests were made as suggested during the experiments. The tests were carried out very carefully and the results are given in detail. The paper was discussed by several members; T. H. Wiggin hoped that similar tests would be made on larger pipes (all pipes tested by Prof. Talbot being 6-inch) and suggested that for the largest pipes the effect of earth pressures should be considered in determining stresses. Mr. Wiggin is a member of the committee on standard specifications for cast iron pipe and specials and incidentally reported progress for that committee, which led J. N. Chester to remark that he would like to see some real progress made by the committee and objected to the idea at one time proposed of a uniform outside diameter for pipes, while C. W. Sherman defended that idea.

Geo. H. Fenkle described the use of "Flow Surveys as an Aid to Fire Protection". He stated that hydrant flow tests had been made in Detroit by a party consisting of five men, two of which were from the fire department. These

used pitot tubes and pressure gauges and had investigated 6,000 hydrants. These hydrants were divided into groups of four to be tested at one time, the pressure gauge being placed at one central hydrant and the other three opened in succession, a pitot reading being made at each hydrant continuously during the openings of the others to note the effect when one, two or three hydrants were flowing. If the pressure at the central hydrant when all three were flowing was less than 10 pounds, it was considered unsatisfactory and a note made to improve the distribution system to remedy the low pressure at that point. In discussing this paper, W. W. Brush stated that in New York a group of men were employed continuously on this kind of work. G. W. Booth considered that this kind of investigation furnished the best proof of the need of reinforcing a distribution system. Several other members took part in a discussion of procedure and advantages of such a survey; one member remarking that Mr. Booth in some cases wanted twenty pounds residual pressure, and Mr. Booth explaining that this pressure was desired when the hydrants had no engine nozzles, since more pressure was needed to furnish the desired amount of water through 2½-inch nozzles, but if there were 4½-inch engine nozzles ten pounds was satisfactory.

The afternoon session opened with a paper by Thomas F. Wolfe entitled "Use of Two Mains in Wide Streets", an abstract of which is published in this issue. E. L. Filby, chief sanitary engineer of the state of Florida, gave an excellent summary of the general characteristics of the water supplies of that state. One of the features of Florida water appears to be excessive hardness, but several cities are arranging for obtaining surface supplies or for softening underground supplies.

"Casting Standard Lengths of Cast Iron Pipe Horizontally" was defended by J. R. McWane who stated that such pipes could be made more cheaply because it was less trouble to prepare the cores and less iron could be used.

A paper on "Service Pipes", comparing the service given by the several materials used for such pipes and recommending copper as best, was read by O. B. Mueller and discussed by several. D. A. Heffernan said that, after 36 years' experience, he preferred cement-lined services. A. Milne, after 40 years' experience in which he had found lead pipe as well as wrought iron corroded by the soil, considered copper best. D. W. French (42 years' experience) had used lead for more than 30 years, but had used brass for three years, found it perfectly satisfactory and much cheaper than lead. Here the competition as to the longevity of experience ended. J. Sterosky was pleased with copper pipe after two years' use. Pat Gear said he preferred an old dudeen to any of them.

Scotland G. Highland presented the result of temperature readings taken at intervals of one foot, from the surface to six feet under a street surface in Clarksburg, W. Va., compared with

air temperatures; also information concerning depth of frost in a number of northern cities.

The subject of fire prevention was discussed by F. H. Wentworth, secretary of the National Fire Protection Ass'n, urging co-operation between the fire and water departments.

No meeting had been scheduled for Wednesday evening, but the experience meeting adjourned from Monday utilized the time from 8 to 10 (the hour set for the "smoker"). Discussing the subject "Advantages and Benefits Derived from Waste Water Surveys" C. C. Betney summed these up briefly but comprehensively, E. S. Cole adding a few by-products such as affording a check on maps and records of mains and valves; discovery of valves unintentionally left open or closed; aid in redesigning the distribution system. (Incidentally, it may be mentioned that three or four of the papers read at the convention told of advantageous use of pitometer surveys.) D. A. Hefferman began making waste surveys in 1890 by installing metered by-passes around valves. A few months ago he located a break within 6 inches by use of a geophone. W. A. McCaffrey had, by pitometer survey, located four leaks in the Oswego system of from $\frac{1}{4}$ to $\frac{3}{4}$ million gallons per day and by stopping these had eliminated the necessity of buying a new pump.

Isaac S. Walker gave suggestions concerning "Essential Log Data that Should Be Kept of the Daily Operations of the Plant by the Chief Engineer", using various boiler room recording apparatus, measuring consumption, etc.

THURSDAY SESSIONS

The morning session opened with a paper (postponed from Wednesday morning) by D. E. Davis, "Study of Currents in Lake Erie at Erie, Pa." in which he told of certain peculiarities of lake currents learned in 1923-24 by use of 160 surface and sub-surface floats, about half of each, in connection with studies for the location of a sewer outlet. Wind was the determining factor, but transference waves swing back and forth through the lake with a certain periodicity, having a maximum vertical range of 8 feet at Buffalo. These are affected by the configuration of the bottom of the lake.

H. T. Critchlow described "The Water Supply Situation in New Jersey" from both engineering and administrative and legal standpoint, Col. A. H. Pratt giving some additional information of the former. Allen Hazen stated that New Jersey, Massachusetts and other states are learning that they should have acquired rights to water sheds years ago, and urged that all states take such action before too late.

A paper "Specifications for Riveted Steel Pipe with Regard to Hydraulic Characteristics" was opened by H. A. Stringfellow with the statement that the "Manual" is unjust to riveted pipe in stating that they have 20 to 25% less carrying capacity than equal sizes of smoother types, while 5 to 10% was more nearly correct and probably grew less with age. Messrs. Pratt, Wiggin, Fenkel and others discussed the paper, all agreeing

that data on which to base precise conclusions were not available.

V. Bernard Siems told how a "Distributor Feeder Survey as a Basis for Improvement Studies" was used with success in Baltimore and a number of feeders of insufficient capacity located and larger ones substituted. The department was aided by the Pitometer Co.'s men, the survey continuing for four months. Recording pressure gauges were used, their elevations compared by reference to city bench marks.

George H. Fenkel, in discussing "Experiences with Water Works Intakes in Great Lakes" gave an excellent summing up of the features of practically all the intakes in the Great Lakes, and compared the advantages of exposed and submerged cribs respectively. The deepest crib is that at Toronto, 100 feet. The least depth for submerged cribs should be about 30 feet, as ice grounds at depths less than this. Exposed cribs have to resist wind, waves and ice. In the discussion Hugh Kellner told how the intake of Windsor, Ontario was for several hours entirely choked with ice and a diver with dynamite kept ready to break open the intake pipe should a fire break out.

C. A. Holmquist told of experiences of New York Cities in discontinuing connections between public and private water supplies; saying that the State Department of Health had found that even the best double check valves are not a sure preventive of contamination of a supply. C. M. Baker called attention to the importance of preventing auxiliary intakes and by-passes as well. In the morning the society had adopted a resolution (adopted last year by the committee) condemning cross connections, and an official of the Factory Mutual Fire Ins. Co. and one or two others engaged in a spirited and persistent attempt to persuade the society to alter its attitude on the subject, renewing the attempt Friday, but without avail. G. W. Booth, speaking for the National Board of Fire Underwriters, said it was content to leave the decision with the members of the A. W. W. A., since theirs was the responsibility for consequences. One of these, a member suggested, might be damage suits against the city or water company by any who might incur typhoid fever as a result of cross connections.

Frank C. Jordan presented the report of the Publicity Committee and introduced John C. Mellett who spoke forcefully on the desirability of giving publicity to water works affairs and men.

FRIDAY SESSIONS

A. F. Mellen told of the present status of the proposition to use iodine in Minneapolis' water supply, stating that the idea (which has not yet been finally adopted) is to use one part of sodium iodide per hundred million of water. So far as he knows, Rochester, N. Y., Sault Ste. Marie, Michigan, and Virginia, Minn., are the only cities in this country which are using iodine in the public water supply. In the discussion, Mr. Little stated that whereas, when Rochester first began using iodine, seven per cent of the school

children examined had indications of goitre, two years later this had fallen to $2\frac{1}{2}$ percent, but the year following that had risen to $3\frac{1}{2}$ percent; there being no explanation of the increase, but the decided decrease from 7 percent being presumably attributable to the use of iodine.

John C. Pritchard described the progress made in the construction of St. Louis's new water works and stated that the plant would probably be in operation by the fall of 1928.

Several topics were then taken up for general discussion. A paper by George D. Norcom discussing troubles with coagulating basins due to foaming and overturning described an occurrence in one city where foaming occurred in a basin receiving water badly contaminated with sea water. He had found foaming more common with colored waters than with clear and suggested that it might be due to CO_2 formed by chemical action or to air which floated the sediment. Coagulating basins should be cleaned as soon as any dead floc is seen passing out. In discussing the subject, Mr. Cramer stated that it is his practice to clean coagulating basins every ten days during warm weather. Mr. Enslow said that at Gatun, Canal Zone, as a regular thing, about one-third of the floc settles to the bottom, one-third floats upon the surface and the balance passes out to the filter, and this happens even though the basins are cleaned every week. Mr. Pirnie stated that in some plants in Florida the basins will run a month without overturning. CO_2 which might cause rising of sediment is gotten rid of after the application of alum by spraying the water.

The subject "Experience with Rewash of Filters" was discussed by James M. Caird who said that in some cases the practice had changed since the use of chlorine became common and the water first passing the filter after washing was no longer wasted; and Mr. Pirnie expressed the same idea. F. W. Green said that at Little Falls, N. J., the first water after washing showed a little higher bacterial content but not seriously. St. Louis was said never to have used pre-wash but after washing starts at a low rate, running about 1 m. g. d. for the first hour. Mr. Enslow was of the opinion that the water first leaving the filter was frequently purer than that immediately following it and that more harm than good was done by the re-wash. Mr. Pirnie described an unusual condition at the Danville plant where a large reservoir made it possible to construct the entire 5 m. g. filter as a single unit in eight sections, the whole eight sections being washed in immediate successions, 3 minutes per section. The "Control of Filter Plants Using the Hydrogen Ion Method" was next discussed, W. A. Taylor opening the discussion and explaining the advantages. C. R. Cox stated that Waterford, N. Y. saves four or five dollars per million gallons by the use of pH over the previous method and this chemical control was really found by the operator to be simpler than old titration methods. An ordinary plant operator has been

operating this plant for over two years without difficulty. The hardness of the water here runs about 70 p. p. m. Other members told of equally satisfactory experiences with the pH method.

Discussing experiences with turbine type meters, James E. Gibson (who was detained at home by an accident to his knee) sent a written discussion, stating that at Charleston such meters sometimes over-registered as much as thirty percent, which was found to be due to the collection of material on the turbine vanes, mostly yarn from joints in the water mains; sometimes leaves and weeds also collected. No such trouble had been found with other designs of meter. G. C. Habermeyer said that in Illinois, in cities using well water with high mineral content, small meters sometimes under-register, while the large master meter on the same system will over-register. An instance was given of the total clogging of meters placed at the upper ends of wells in the Arcola water system. One case was reported of a Venturi meter which over-registered fifty percent because of incrustation of the meter tubes.

Discussing the subject of flush valves, E. C. Groner stated that more than 400,000 of these had been installed in 1925, mostly in hotels and other public toilets. Services should be large enough to supply at least 30 gallons a minute at a pressure of at least five pounds per square inch, since this amount may be required by the overlapping use of several fixtures at once, and plumbers now generally require this where flush valves are used. An objection to installing them is the greater cost to the consumer for services and meters, and to the water company because with the larger meters there is more slip and the meters are less sensitive. A member suggested the use of a kitchen boiler as a pressure tank to eliminate the necessity of large service pipes, the size of the tank to be governed by the size of the service pipe and the pressure in the mains; the air in the tank to be renewed when necessary either by draining the tank or by using an automobile pump. So far as quantity is concerned, it was stated that the flush valve is really economical, using only 3 or $3\frac{1}{2}$ gallons where the ordinary gravity tank uses from 6 to 15 gallons. W. J. Willson said that in Greenwich, Conn. a $\frac{3}{4}$ -inch or $\frac{5}{8}$ -inch tap with a 1-inch pipe and meter were furnished free by the company for serving five flushometers and asked whether this was fair to the water company. It was stated that in Kitchener, Canada, the consumer pays according to the size of service which he asks for.

In the afternoon, Frank E. Hale briefly described three interesting experiences of last year in connection with algae, which paper is published in this issue of *Public Works*. Discussing it, W. W. Watkins stated that he had used chlorine successfully to reduce asterionella.

Referring to the flushing of mains to overcome odors and tastes, Mr. Cramer stated that he had found water in the smaller 4-inch pipe of a two-main system tends to get stagnant, even though the pipe be connected into the system at

both ends. No trouble is experienced, however, as the entire system is flushed every two weeks in the summer anyhow in order to please the health department. Mr. Brush stated that in New York City a gang is employed continuously in flushing dead ends, such flushing being done at intervals of from two weeks to two months. A dead end may be due in some cases to closed valves at district boundaries. One city which entertains many summer visitors flushes its mains each spring just before the visitors arrive, there being considerable trouble with red water.

Discussion of the "Sterilization of New Water Mains After Laying and Before Putting into Service" was opened by Mr. Brush, who stated that New York specifications require that chloride of lime be placed in mains when they are laid, one-half ounce in each length of pipe, or an amount placed on each side of each valve giving an equivalent quantity. The pipe is then filled for testing and allowed to stand, and then the contained water blown out; the mains sometimes being blown out several times until the water comes perfectly clear. A 24-inch pipe laid in Rockaway below water level was polluted by leakage from leaky sewers which reached the water main trench and after the pipe had been laid liquid chlorine was introduced at the end of the line at the rate of 3 p. p. m. residual chlorine and the water so treated held in the line 24 hours and flushed out. One or two days later the water was found to be high in bacteria, which had probably been retained in sand which had collected in the bottom of the mains and which had not been reached by the chlorine or flushed out with the water; and this line had to be flushed three times at high velocity for two or three hours each time until the sand had been entirely flushed out. This practice of treating with chloride of lime began in New York about twenty years ago. The question was asked what members present practiced sterilizing mains in this way and the only ones responding were representatives from Charleston, S. C. and St. Petersburg, Fla., the latter, Mr. Lane, stating that his practice is practically the same as at New York. One member narrated that the Layne-Bowler Company some years ago found B. Coli in water coming from a well just driven by them, apparently from gravel which had been introduced around the well pipe; since which time the company uses only thoroughly washed gravel for this purpose.

A number of members gave interesting experiences with deLavaud pipe. P. J. Hurtgen said Kenosha laid about 2,000 feet in 1923, the pipe being unloaded and handled in the same way as had been the practice with ordinary sand-cast pipe, by dropping from the wagon onto the side of the road, and that twelve pieces were broken in distributing. Later, cold weather coming before the pipes were laid, they froze to the surface and other lengths were broken in trying to pry them loose. One pipe broke in two in the trench after being laid, probably because the bell-hole had been dug too deep. Altogether,

29 pieces were rejected out of 126. This was practically the only unfavorable experience with this pipe reported, several other members expressing satisfaction with it. J. Shehan said that in 1922 and 1923 Memphis had been unable to get some badly needed pipe and in the latter year obtained immediate delivery of de Lavaud pipe. There was some breakage and trouble in cutting the pipe with the first shipment but the men soon learned how to handle it and the city now uses it for all pipe 12-inches and under, having laid sixty miles of it. S. H. Taylor said that since the beginning of 1925 New Bedford had used this pipe exclusively for 4-inch to 12-inch sizes, finding it of much more uniform thickness and smoother, and with less breakage than the old style pipe in delivering between car and trench. That city has 10 miles in use and there has been only one breakage. The cost is ten per cent. less than that of sand-cast pipe. R. B. Morse said that the Washington Suburban Sanitary District has purchased ninety miles of 6-inch to 20-inch deLavaud pipe and has experienced no difficulty with it except that three lengths of 12-inch pipe cracked while being cut; and 8 to 10 pieces of one shipment split after being laid, it being thought that they had been cracked by careless handling on the cars. The men now prefer it to the sand-cast and the prices are five to ten per cent. less. F. W. Alvord said that in Knoxville, in May, 1925, 1,200 ft. of 12-inch main was needed and only deLavaud pipe could be obtained and it was accordingly used. The city was instructed to handle the pipe with care and in cutting it to use a sharp chisel and a light hammer. No difficulty was experienced, the line laid is 100 per cent. perfect and the city now uses nothing else, having 150,000 feet in use. All pipe used by them is cement lined.

C. W. Sherman had used 12 miles of deLavaud pipe at Belmont, Mass., and his experience was entirely favorable. The cost was 5 to 10 per cent. less than for sand-cast, class B, and breakage about the same. When tapped, a beautiful thread was obtained and a tight joint.

Mr. Heffernan has just laid 2,300 ft of 6-in. to 16-in. pipe of this kind, cement lined. Not a length was injured in handling and cutting and the test showed a tight line. St. Petersburg, Fla., has contracted for 60 to 70 miles of 6 and 8-inch. Brantford, Canada, obtains excellent results using a wheel cutter. Atlantic City, N. J., this year is laying all 6-in. to 12-in. pipe of this kind, finding it perfectly satisfactory.

Discussion of "Experience With Cement-Lined Cast Iron Pipe" was opened by a paper from Mr. Gibson. He had found an average thickness of cement of 1/16 inch too thin, as pimples in the iron projected through the cement, which was only 1/64 inch thick in places. With 1/8-inch thickness this is avoided. Cement lining he considered especially good for aggressive, peaty water. Mr. Pirnie had laid 20 miles of such pipe in West Palm Beach in 1924 and 26 miles last year. The early pipe had too thin a lining and tubercles formed; now it is called for 3/32-inch thick with 1/32-inch tolerance up to 12 inches

diameter, and $\frac{1}{8}$ -inch for larger pipe. H. Y. Carson showed on the screen and explained micro-photographs of cement linings. Mr. Wiggin cautioned against getting the cement too thin, Mr.

Heffernan and others against getting it too thick, as the thicker it is the poorer the bond with the iron and when $\frac{1}{2}$ inch thick there is no bond at all.

Sewage Treatment In Chicago

Ten million dollars worth of work under contract and seventy million dollars more to be spent, in addition to the millions already spent for sewage treatment plants, make this the most extensive program ever undertaken by any municipality

Chicago is confronted with a larger sewage treatment problem than any other city in the United States. Probably few even of its own citizens realize the extent of the work which has been done, is being done, and is contemplated as one of the future necessities. The sewerage of the city and immediate vicinity is in charge of a board of trustees of a district known as The Sanitary District of Chicago, which board raises its own funds for meeting the necessary expenses by taxation:

In 1925 the U. S. Supreme Court decided that it rested with the Secretary of War to control the amount of water which could be withdrawn by the sanitary district from Lake Michigan for diluting the sewage in the drainage canal, and the secretary granted a five-year permit for withdrawing 8,500 cubic feet per second, conditioned upon the performance by the district and the city of Chicago of certain obligations, of which the most important were the vigorous prosecution of a program for artificial sewage treatment, the metering of the Chicago water supply, and the construction of flood control gates in the Chicago river.

In July, 1925, the Illinois state legislature granted the district 1% additional bonding power for the specific purpose of construction of sewage treatment works and adjuncts and for settlement of Illinois valley overflow claims. The dis-

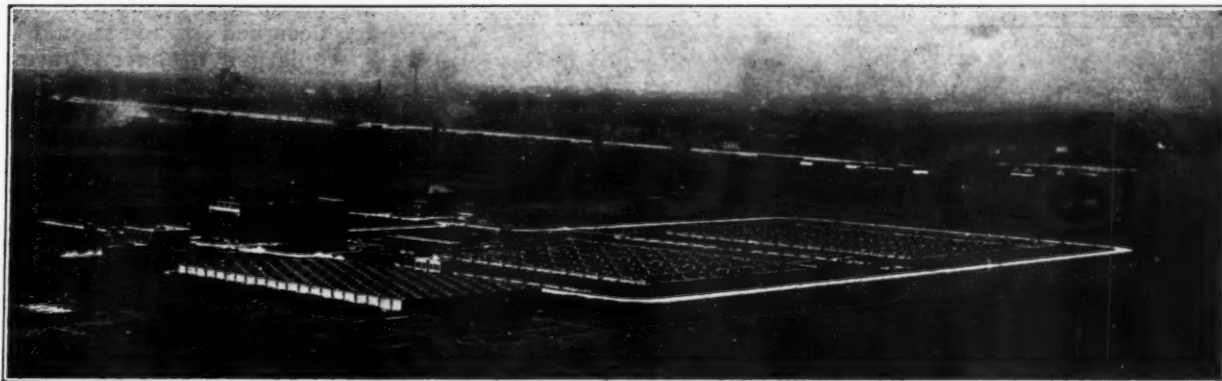
trict shortly thereafter submitted to the United States engineer a definite construction program calculated to fulfill the requirements of the permit, which was approved on July 28th, 1926. On September 1st the city council passed a metering ordinance which satisfied that condition of the government permit. During the year the district completed work amounting to approximately fourteen million dollars, and during the last half of the year awarded contracts for construction work totaling over eight million dollars.

In 1923, the Illinois legislature amended the enabling act of the Sanitary District and required that sewage treatment works be put in operation annually, beginning with 1925, at the rate of 300,000 persons per year until provision had been made for approximately 1,800,000 population. The requirements connected with the permit issued in 1925 by the Secretary of War imposed additional requirements and a program was prepared in five year periods looking toward the ultimate completion of a system of intercepting sewers, pumping stations and treatment works whereby all the suspended solids will be removed and the liquid pollution so reduced biologically that the main channel and Illinois river will be cleaned up.

The work which the commission is required to perform is not confined entirely to sewage treat-



DES PLAINES RIVER SEWAGE TREATMENT WORKS
Aeration and settling tanks in foreground. Sludge pressing and drying house, and storehouse, in rear.

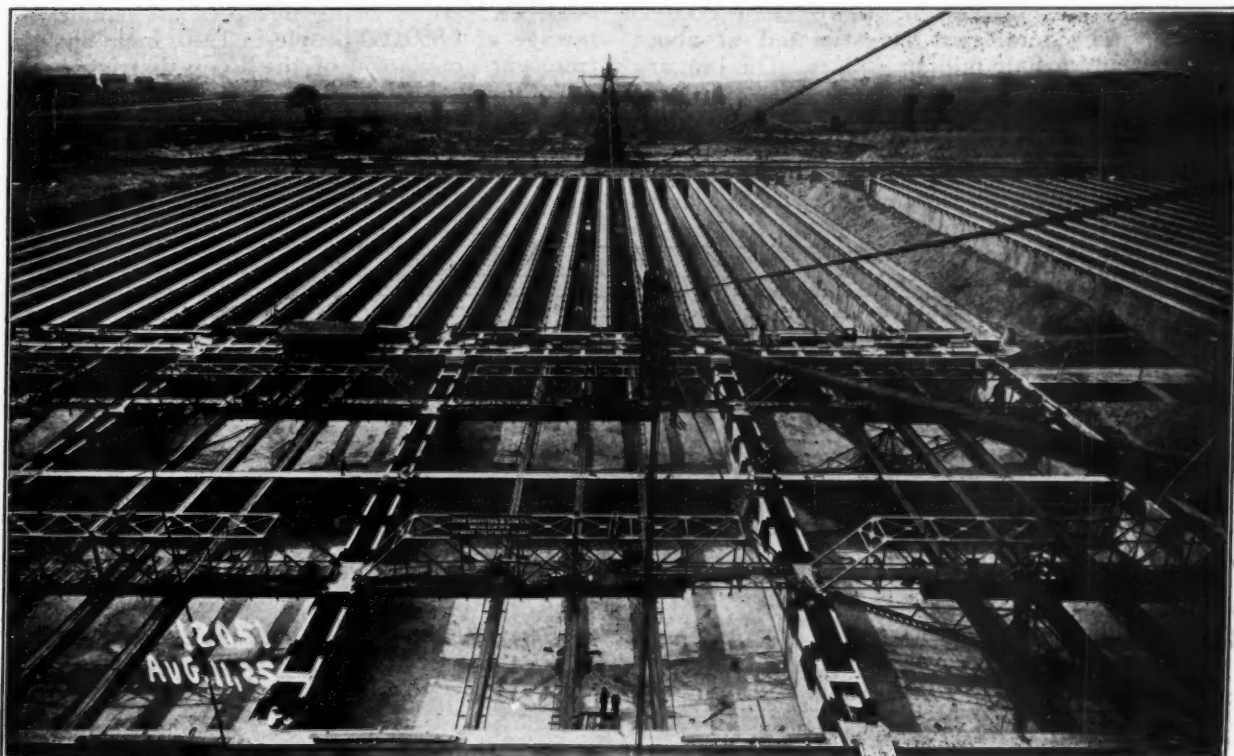


CALUMET SEWAGE TREATMENT WORKS
Entire plant. Trickling filter in foreground. Imhoff tanks in middle. Calumet sewage pumping station in background on right.

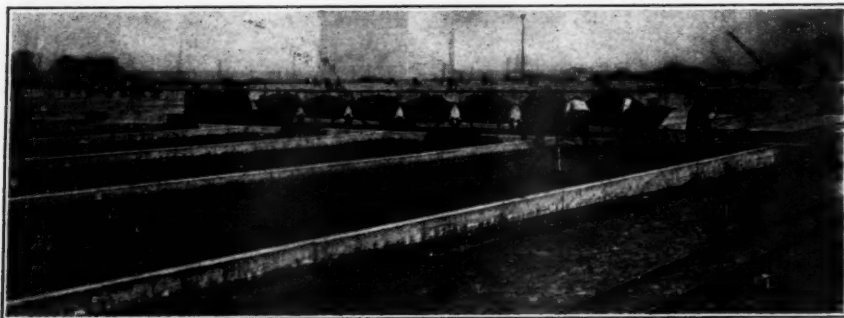
ment plants, including pumping stations, but also includes bridges over the drainage canal, retaining walls, subways, outfall and intercepting sewers, and other work incidental to maintaining the canal and bringing the sewage to the treatment works. A bald list of the work under contract and which should be started in the near future occupies $3\frac{1}{2}$ printed pages. Some of the more important items are as follows: Under Contract—North side intercepting sewer, \$1,799,000; north side sewage treatment works, \$4,005,000. Completion of Projects Under Way—North branch pumping station, \$3,000,000; Des Plaines River sewage treatment works additions, \$400,000; Calumet sewage treatment works additions, \$3,693,000; north side sewage treatment works (not yet under contract), \$3,530,000. Work which has not yet been started but should be

begun this year include the west side intercepting sewer, \$15,800,000; Salt Creek intercepting sewer, \$1,500,000; Oak Forest outlet sewer, \$600,000; industrial wastes intercepting sewer, \$850,000; west side treatment works, \$13,410,000; industrial wastes treatment plant, \$1,300,000; additional treatment works, \$1,100,000; southwest side sewage treatment site, \$500,000. There will be needed in the future, although not immediately, a Racine Avenue pumping station, \$3,000,000; southwest side intercepting sewer, \$8,800,000; southwest side sewage treatment works, \$7,200,000; north shore intercepting sewer extensions, \$1,000,000; power service for north side sewage treatment works, \$5,000,000, and various other items of under one million dollars each.

In reporting on this work, the chief engineer, E. J. Kelly, describes briefly the condition of



NORTH SIDE SEWAGE TREATMENT WORKS
Settling tanks in foreground. Aeration tanks in background.



CALUMET SEWAGE TREATMENT WORKS
Removing air-dried sludge from drying bed by hand.

each of the various projects on January 1, 1926. The Calumet intercepting sewer system is practically completed and is receiving all the dry weather flow from the territory served. The North side intercepting sewer, the main feeder to the north side sewage treatment works, should be completed simultaneously with such works. Part of this sewer was completed in 1922 at a cost of two million dollars, providing an outlet for the sewage of the city of Evanston and the north shore towns up to the Lake County line. Another section of this sewer was about 96% completed on January first, while a third section had not yet been contracted for and five other sections are in various stages of construction.

The North Side sewage treatment works, designed to treat all the sanitary sewage originating in Chicago north of Fullerton Avenue, together with the sewage from north shore towns to the Lake County line, will have a capacity to handle the sewage of more than 800,000 people. The total cost is estimated at about thirteen and a half million dollars. On January first the tanks and galleries were 93% completed, the thickener mechanisms 99%, sluice gates and aeration plates were entirely completed, centrifugal pumps 96% complete; while of other items such as meters, blowers, electrical equipment, grit chambers, air conditioning equipment, pump and blower house and other details, none was more than 46% completed and the pump and blower house had not yet been started. The completion of this work by 1928 is the most important duty of the trustees.

The North Branch sewage pumping station is a necessary link in the north side intercepting sewer system and will replace the existing Lawrence Avenue pumping station with a larger station, electrically operated. It is estimated to cost about \$1,300,000.

The Des Plaines River sewage treatment works is already handling somewhat

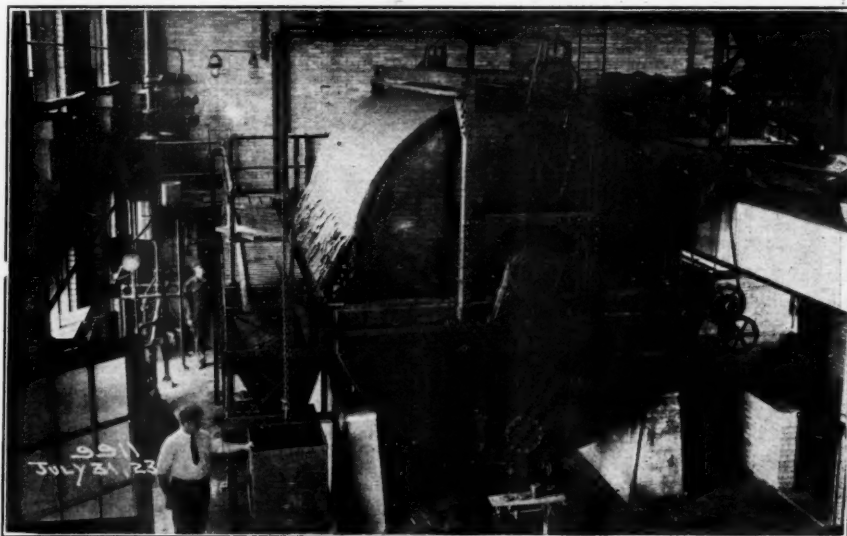
more sewage than it was designed for and should be enlarged at once. Future enlargement was provided for when the works were built and ample land is available. The estimated cost of the enlargement necessary is \$325,000 with an additional \$75,000 for a sludge line.

The Calumet sewage treatment works have almost reached the point where additional biological treatment is needed and it

is proposed to install trickling filters following the Imhoff tanks; also additional sludge drying beds. It is also recommended that experimental work to aid in devising or selecting machinery for cleaning sludge drying beds should be installed at the Calumet works; also tests made of devices for indicating sludge levels in settling tanks before their actual use in the North Side sewage treatment works.

The next step in the sewage treatment program in the district is the construction of the West Side sewage treatment works which will serve that part of Chicago north of the south branch of the main channel not served by the North Side works, together with the Loop district and some territory immediately adjacent thereto. Preliminary studies have been made for these works and borings and test pits sunk to determine soil conditions. This plant will consist of Imhoff or double deck tanks with a sewage pumping station, grit chambers, drying beds, etc. It is being designed to handle the sewage of 1,850,000 people in 1940, including the transient population of the Loop district:

To meet the conditions of the Secretary of War, a number of additional sewage treatment works will be required for outlying communities such as Calumet City and Burnham. An available site for the former has already been located.



CALUMET SEWAGE TREATMENT WORKS
Oliver filter for dewatering sludge.

The last sewage treatment upon the list is that designated as the South West Side. Some preliminary studies for these may be started toward the end of 1926, but no work is contemplated for some time to come. Ultimately, a treatment plant will be required for a group of villages on the Des Plaines river comprising Des Plaines, River View and Park Ridge, which were annexed to the district about four years ago. A small separate plant will also be required for the village of Harvey, which is too far distant from the Calumet works to make it economical to bring sewage to that plant.

The Calumet sewage treatment works have been in operation since September, 1922, and the Des Plaines river works since August, 1922, the sludge press and dry house of the latter having gone into operation in October of that year. In the Calumet works an Oliver filter is used and in the Des Plaines works a Berrigan press and Worthington press. The Morton Grove sewage works is now in good operating condition as are also the Glenview sewage plant and the North Brook sewage plant, the last of which was put in operation in April, 1926.

New York's Experiences With Copper Sulphate

Foul taste following treatment causes new method of procedure. Use of distributing reservoir during treatment. Fifteen tons of copper sulphate used in a period of eighteen days.

By Frank E. Hale*

Out of the year's experiences with New York City water supplies, three may be mentioned as of general interest.

PROCEDURE FOR COPPER SULPHATE TREATMENT

On August 25, 1925, Jerome Park reservoir was treated with copper sulphate for Asterionella, 1500 units, dosage 0.18 ppm. Contrary to usual practice, the reservoir was not turned into service again until September 8, two weeks later. Within a few hours some three hundred complaints of foul-tasting water were received over the telephone. The reservoir was immediately shut off again. Samples examined from top, middle and bottom depths indicated that the decaying organisms had concentrated in the bottom water; and as draft was from the bottom, the full effect of the treatment was experienced. The complaints were well justified, judging from certain of the samples received. Usually taste and odor from treatment disappear in two to three days and experience like the above has not been noted.

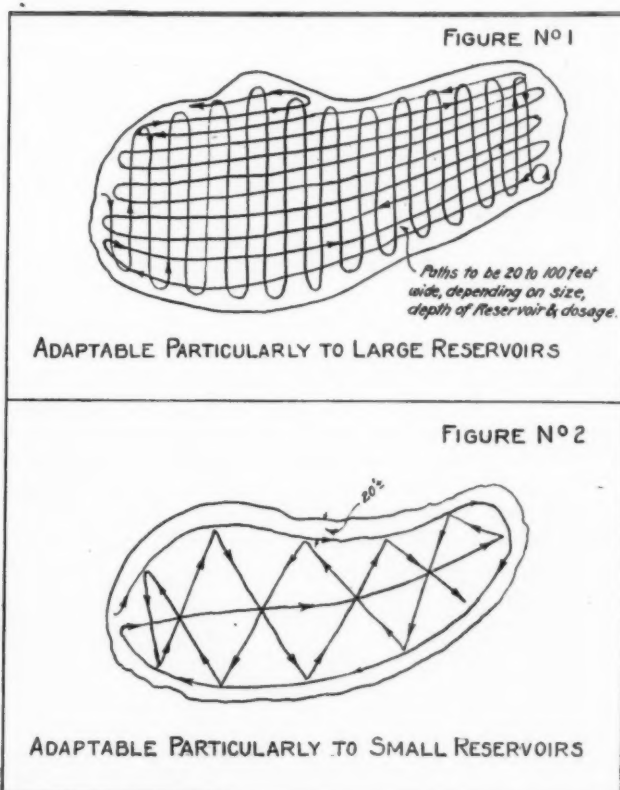
Meantime a secondary growth of Dinobryon occurred, 1550 units, the Protozoa probably feed-

ing on the decaying Asterionella or on the bacteria (which rapidly increase following the killing of microscopic organisms), since the Dinobryon predominated at the bottom. A second treatment was given on September 14 of the same dosage and it is interesting to note that though, as usual, the surface water was treated, the organisms which were at the bottom were entirely destroyed. The depth of the reservoir is about 25 feet. Great care was exercised in turning the water on again. Samples from top, middle and bottom were again examined and the reservoir turned into service gradually from mid-depth, beginning on the 19th. By the 24th it was about one-half in service, all that could be taken from mid-depth. Bottom draft was then commenced and increased until the reservoir was entirely in service. As the reservoir was turned gradually into service, observations of taste were made there frequently, both of the effluent and of the bypassed water.

As a result of this experience, a new procedure for treatment and putting into service of reservoirs was outlined and distributed. The main points of this procedure are:

(1) Care in distributing the copper sulphate rapidly and uniformly. The accompanying diagram shows the course of the boats for large and for small reservoirs. On large reservoirs the courses are parallel in one direction and then parallel in a direction at right angles to the first. On small reservoirs the courses triangulate the surface.

(2) Prompt inspection, if possible the third day after the treatment, noting local conditions,



SKETCH SHOWING METHODS TO BE USED IN DISTRIBUTING COPPER SULPHATE IN RESERVOIRS

*Director of Laboratories, Dept. of Water Supply, Gas and Electricity, New York City. Paper before American Water Works Ass'n.

such as odor arising from the surface of the water, particularly to leeward of any wind, and physical appearance of the water. Laboratory examination of samples should note whether organisms are dead, in process of decomposition, or mere shells; particularly noting the appearance of coloring matter, whether faded or jumbled in appearance; also the promptness with which organisms settle in the bottles on standing.

(3) Prompt turning of the reservoir into service on notification.

(4) Wherever possible, when turning a reservoir into service again, the flow should be established gradually, mixing effluent water with bypassed water, and noting turbidity, taste and odor of both effluent and mixed flow. If required, this process may take several days.

(5) Every effort should be made to prevent stirring up deposits either in reservoirs or in conduits which have been idle or full of stagnant water.

(6) If possible, avoid drawing water from the extreme bottom of a reservoir following treatment. Mid-depth or at least ten feet above the bottom is preferable. Surface draft may sometimes be advisable, but should not be continued, in order to avoid stagnation effects in the reservoir.

USING RESERVOIR DURING TREATMENT

On April 19, 1926, the influent half of Central Park reservoir was treated with copper sulphate for 1150 units of *Asterionella*, dosage 0.25 ppm. The interesting part of this treatment is that the reservoir was kept in service during treatment. It is oval-shaped and water enters at one end and leaves at the other. At present rate of draft, the water of the lower half of the reservoir would be displaced in ten days, hence the treated half could not reach the consumer until free from taste and odor due to treatment. The results of microscopical examinations of the effluent were as follows:

| | <i>Asterionella</i> | Total Organisms |
|----------|---------------------|-----------------|
| April 15 | 1150 | 2040 |
| " 22 | 1350 | 2100 |
| " 29 | 370 | 500 |

A variety of organisms were present, such as *Molosira*, *Synedra*, *Aphanizomenon*, in addition to the *Asterionella*, which were also greatly reduced. Similar treatments in recent years have been successfully given for 10,000 units of *Synedra*, dosage 0.36 ppm. (3 lbs. per mg.), and for 4000 units of *Dinobryon*, dosage 0.20 ppm.

USING FIFTEEN TONS IN EIGHTEEN DAYS

Recently *Synura* has been heavily prevalent in the Croton watershed. A few units were present daily in the Croton aqueduct water for several weeks, on April 22nd to May 8th 3 or 4 units per cc., and May 8th to May 15th, 1 unit. Chlorination, 0.54 ppm., has taken care of the aqueduct water, but extensive treatment of the watershed reservoirs with copper sulphate was carried out. Continuous treatments by suspended

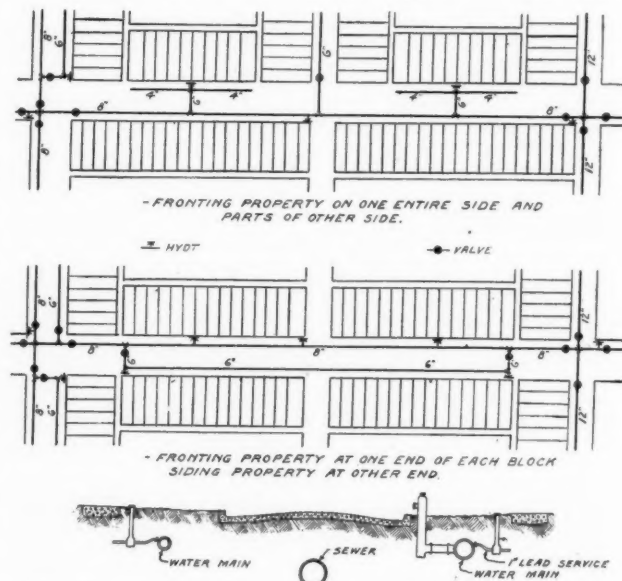
bags were temporarily made of Sodom reservoir effluent and at Muscoot Dam, April 20th to 26th. The following table gives the data of these treatments:

| Date | Location | Lbs. | Copper Sulphate dose lb. per mg. | <i>Synura</i> Units per cc. |
|--------------------------|--|--------|-------------------------------------|--------------------------------|
| Continuous Apr. 20-26 | Sodom eff. & Muscoot Dam..... | 1800 | 1 | 100 |
| May 3-7 | Bog Brook reservoir | 4500 | 1 | 325 |
| Apr. 23-24 | Sodom reservoir... | 7650 | 1½ | 1300 |
| Apr. 26 | Diverting Basin... | 900 | 1½ | 250 |
| " 26-29 | Muscoot reservoir. | 7200 | 1½ | 125 |
| " 26-30 | Croton Lake (Muscoot Dam to Old Dam) | 8550 | 1 | 150 |
| Total | | 30,600 | | |

Five boats were used, including one launch. The *Synura* was entirely destroyed. Dosage was figured on total volume of water at time of treatment. This treatment is interesting on account of its extensiveness. Similar treatment was carried out in 1923 for *Aphanizomenon*, dosage 1 lb. per mg. It recalls also the complete treatment of Kensico reservoir in the winter of 1923 (Dec. 8-30) with 20 tons of copper sulphate for *Synura*, dosage 1 lb. per mg.

Two-Main System of Distribution

In a paper before the American Waterworks Association, Thomas F. Wolfe, research engineer, Cast Iron Pipe Publicity Bureau, advocated the use, under certain conditions at least, of two water mains in wide streets. The pipe on one side of the street would be of sufficient size to provide for domestic consumption and also for fire protection, while on the other side would be one of smaller diameter, usually four inches or six inches; each line being tapped for services



THE TWO-MAIN SYSTEM OF WATER DISTRIBUTION

on its own side of the street only, and the smaller line having no fire hydrants connected to it.

Among the advantages claimed for this are that there is then no excuse for the city to require that services be laid to each lot before paving the street, since no pavement is disturbed in laying services later. This permits each service pipe to be laid of the size and in the location actually desired, instead of laying a small service at intervals assumed to be those of the width of lots into which the property will later be divided; many of which services will never be used because they are in the wrong location, of the wrong size or, most frequently, only one may be required for a large building where several have been provided. "The result is that many dead services now exist in our streets that represent an investment of a considerable amount of money and which have never been put to any use. The loss is not limited to money spent in laying these services since we know it to be a fact that dead services are a prolific cause of trouble and it very often becomes necessary to finally cut them off at the main in order to keep down maintenance cost".

The accompanying sketches show some vari-

ations of the system where it is not necessary to provide mains for service connections along the entire frontage of a block.

As to the relative cost of the two systems, this can be determined in each case by calculating the cost of the main required for fire protection and for efficient distribution to districts beyond, to which cost would be added in one case services carried to the building on both sides of the street (including in this such cost as may be required for replacing the roadway pavement); and in the other case, adding the cost of an additional four-inch main and the cost of services carried from the two mains to the buildings, these services being much shorter because of the nearness of the mains to the buildings. It is apparent that in the case of very wide streets, the latter cost will be less than the former, the width where this condition begins depending upon the relative costs of laying mains and services.

The author refers to making the second local main of four-inch or six-inch pipe, but we can see no reason why a two-inch pipe should not be sufficient where not more than six or eight houses are to be served by a single line of secondary main.

Assessment of Corner Lots

Statutes, ordinances and court decisions and interpretations on this subject. Significance of terms "abutting," "fronting on" and "adjoining." Partial exemption of corner lots

By John Simpson

The general rule for the assessment of corner lots under statutes and ordinances placing the cost or part of the cost of public improvements upon the adjoining properties in proportion to the benefits received by them is that a corner lot is assessable for the cost of improving the streets along both sides on which it abuts, regardless of which is the front unless a contrary intention clearly appears. The reason usually given for the adoption of this rule is that corner lots have more advantages and therefore greater value than lots fronting only on one street, and that a different rule would be oppressive as to interior lot owners. While the assessment on the corner lot may be double or treble that on the other lots, the difference in value is considered approximately at least to offset the inequality of the assessment. *City of Springfield v. Green*, 120 Ill. 269. Compare *Weeks v. City of Milwaukee*, 10 Wis. 242, 258.

A corner lot, it has been said, faces or fronts on two streets. It has a frontage on both streets though the house built upon it may have its principal door for egress and ingress facing only one street. A corner lot which faced 80 feet on B street and 22 feet on A avenue was held to front on B street and to be assessable for a lateral sewer as a lot fronting on the street through which it runs, in proportion to benefit received.

People v. Adams, 18 N. Y. Supp. 443. And this is so although the lot is numbered only on one of the streets on which it abuts, and there is no front opening on the other street, the one to be improved. *Elder v. Cassilly* (Ky.) 54 S. W. 836.

The principle has been applied to the construction of sidewalks as well as to streets and sewers. *Tripp v. City of Yankton*, 10 S. Dak. 516; *Sands v. City of Richmond*, 72 Va. 571; *Lawrence v. Killam*, 11 Kan. 499.

Assessments upon the same corner lot for similar improvements made upon the two streets bordering its front and side lines do not constitute double taxation. *Durst v. City of Des Moines*, 164 Iowa 82; *Morrison v. Hershire*, 32 Iowa 271; *City of Des Moines v. Dorr*, 31 Iowa 82.

In *Allen v. Krenning*, 23 Mo. App. 561, it was held that under a provision of the charter of the city of St. Louis, limiting assessments for special taxes to 25 per cent. of the assessed value of the property, a corner lot might be assessed to an amount not exceeding 25 per cent. of its assessed value for the improvement of each street, though the improvements were of the same character and made at substantially the same time.

FRONT FOOT RULE APPLIED TO SIDE OF LOT

The "front foot" rule of assessment for a street improvement is held, *Moberly v. Hogan*, 131 Mo.

19, to be applicable to a corner lot as a basis for taxation, according to its frontage upon the improvement, irrespective of the fact that the lot has a front upon another street which meets the improved one at a right angle. The defendant here unsuccessfully contended that his corner lot had been erroneously assessed on a foot frontage of 120 feet, but that this was the length of the side of the lot abutting on the improved street, and that it should have been assessed upon its 25 foot front upon the other street. See also *Collier Estate v. Western Paving & Supply Co.*, 180 Mo. 362, 377.

In *Mowler v. City of Benton Harbor*, 134 Mich. 401, it was held that, under Mich. Comp. Laws, 1907, §3196, fixing a limit for special assessments "upon any lot or premises for any one improvement" of 25 per cent. of the value of the lot or land, and §3295, fixing a limit of 5 per cent. for all assessments, it is competent to assess a corner lot as an entire parcel in two assessment districts for paving each street for 25 per cent. of its value for each improvement, but the annual tax for both improvements must be restricted to 5 per cent. of the assessed valuation as shown by the last preceding roll. Following this case, it was held, in *re Johnson's Estate*, 177 Mich. 500, that an improvement tax for paving may be assessed against a corner lot for work done on both streets on which it lies, since it is benefited by the pavement on either street, provided no greater burden is imposed than the statute permits.

THE OHIO CASES

For a time the Ohio courts followed a doctrine different from that of other jurisdictions, holding that a lot fronted only on the street which it fronted breadthwise, but in 1914 the Ohio Supreme Court, overruling its former decisions (*Haviland v. Columbus*, 50 Ohio St. 471, and *Toledo v. Shiell*, 53 Ohio St. 447) in *City of Youngstown v. Fishel*, 89 Ohio St. 247 (1914) 104 N. E. 141, held that the third alternative method of assessment provided by Ohio General Code, §3812, which reads: "By the foot front of the property bounding and abutting upon the improvement," means that corner lot owners are to be assessed for the full frontage of their lots abutting or bounding on the improvement, whether lengthwise or breadthwise, and this holding was made disregarding any distinction as to the technical meaning of the term "front" or "frontage."

In the *Haviland* case, it was held that if a lot abutted lengthwise on the improvement, but fronted breadthwise on another street, and not on the improvement, the lot should be deemed as fronting breadthwise on the improvement, and be assessed for the number of feet on the improvement that it would have in such case and no more; as, for example, if X owned a lot at the corner of A and B streets, 50 feet on A and 150 feet on B, the 50 feet being its breadth and 150 feet its length, and B street was being improved, X could be assessed for only 50 of its

150 feet abutting on B street, and the interior lot owners on B street must of necessity participate in the additional assessment, and X's additional 100 feet was improved substantially at his neighbors' expense.

It appears to have been generally felt by the citizens of the state that the rule of the *Haviland* case had worked injustice to a greater or less degree in almost every municipality of the state, and that it had been the source of much irritation in every community where street and sidewalk improvements had been made. The court in *Youngstown v. Fishel* said: "It is the plain duty of the court to see that reasonable uniformity is observed in the imposition of the burden of assessments among all property owners. It must be conceded on all sides that the *Haviland*-case rule is a hard rule—one strongly calculated to raise murmurings and discontent, and it must likewise be conceded that the exercise of the power of assessment under this rule has been grossly oppressive to interior lot owners; and so, without pursuing the subject at greater length, the majority of the court is quite content to adopt as the best line of reasoning on the subject the able dissenting opinion of Shanck, J., as announced in the *Shiell* case supra, and to hold that the plain meaning of the term 'front' as employed in section 3812, General Code, is the real and actual frontage, both lengthwise and breadthwise."

WHERE STATUTE USES WORD "ABUTTING"

Kentucky St. 1903, section 3105, provided that in cities of the second class the general council should have power to construct sewers and might assess the cost to an amount not exceeding \$1 per front foot of the abutting property on lots and lands abutting on the street. Where a corner lot had been assessed under this statute \$1 per front foot on one of the streets on which it abutted, for the construction of a sewer along that street, it was nevertheless held liable for an assessment for the construction of a sewer along the other street. *Rich v. Woods*, 118 Ky. 865. The court said: "A lot fronting on two streets has more advantages, and consequently more value, than if it fronted on one only. As equality of public burdens is a cardinal consideration in their imposition, it must follow that the lot that gets twice as much advantage from a public improvement as another must pay twice as much of the cost of the improvement as the latter. The basis of advantage is necessarily more or less arbitrarily fixed, yet approximate equality, at least, is attained by the adoption of either the front-foot theory or that of the square feet of a given area."

Quoting this case, it was said, in *McGarvey v. Swan*, 117 Wyo. 120, 127: "It is very clear that the mere fact that a corner lot has once had an assessment imposed upon it for the construction of a sewer in front of it along one of the streets upon which it abuts does not necessarily furnish a constitutional reason why it may not be subsequently assessed for the construction of a sewer

along and through the other street upon which it abuts."

Rich v. Woods was followed in a sewer assessment case where the circumstances were similar, *Gesser v. John B. McLane & Co.*, 156 Ky. 743. The court said: "It is a hardship, of course, but it is a hardship growing out of the disadvantage of owning a corner lot."

In *Anderson v. Ritzer*, 20 Ky. L. Rep. 1450, 49 S. W. 442, it was held that a corner lot must be charged with its proportionate share of the cost of a sidewalk on both streets, the statute making it responsible for the street intersection.

In *Meyer v. City of Covington*, 103 Ky. 547, it was held that the lot adjoining or bordering on the street to be improved was in law abutting property and therefore liable to be assessed for the widening of a street or alley along the side thereof. To the same effect, *Seibert v. Tiffany*, 3 Mo. App. 33.

In *City of Springfield v. Green*, 120 Ill. 269, it was held that, considering the whole of a paving ordinance, the word "abutting" therein was intended to apply to lots whose sides as well as ends were bounded by the line of the streets to be improved, and that where the streets in front and at the side were both to be paved, it was the intention of the council that the corner lot should bear one-half of the expense of the improvement in front of the side as well as of the end of the lot. Any other construction of the ordinance would have left no provision whatever for paying for the pavement of these parts of the streets directed to be improved, which lay in front of the sides of lots located on the line of said streets.

The court said that the question resolved itself into this: Can we say, as matter of law, that an ordinance which requires lot owners to pay for the improvement of the street or streets by which their respective lots are bounded, is so oppressive and unjust to the owners of corner lots as to justify a court in declaring the ordinance void? The tax on the corner lots, in the present scheme, is, on an average, a fraction over three times as much as it is on the other lots; yet, after all, the difference in value and advantages between corner lots and those which are not, may, in a great degree, if not entirely, make up for the inequality in the tax. Doubtless, these matters were all taken into consideration by the city council in framing the ordinance, and, everything considered, we are unable to say that the ordinance is so manifestly oppressive and unjust as to render it void.

City of Springfield v. Green was followed in *Wilbur v. City of Springfield*, 123 Ill. 395, where the ordinance and the circumstances were similar.

WHERE STATUTE USES WORDS "FRONTING ON OR ADJOINING"

The Missouri Supreme Court held, in *Collier Estate vs. Western Paving & Supply Co.*, 180 Mo. 362, that where the charter says that taxes for the improvement of streets shall be levied upon "ground fronting upon or adjoining the improvement," the words mean the street upon which the lot fronts and the side street

which it may adjoin. Where these words are used in reference to the front foot assessment, the amount of the assessment is the same whatever the depth of the lot.

Under a statute providing that the city has a right "to improve the streets or other public ways at the cost of the owners of ground fronting or abutting thereon," and that the cost of such improvements should not exceed one-half the value of the ground after the improvements were made, excluding the value of buildings thereon, it was held that the city had authority to assess against the owner of a corner lot an amount not exceeding one-half of the value for the improvement of each street, independently of the charge against the other street. *City of Latonia vs. Carroll*, 151 Ky. 165; *City of Covington vs. Schlosser*, 141 Ky. 838.

In the latter of these cases the court arrived at the following conclusions: "First: That when a corner lot is assessed for the cost of 'improving the streets or other public ways' upon one street upon which it abuts, the cost of this improvement is not to be considered in estimating the charge that may be made against the lot for improving the other street on which it abuts. But the cost of improving each street, independent of the other, cannot exceed one-half the value of the ground, after the improvement is made, 'excluding the value of the buildings and other improvements upon the property so improved.' Second: That when such a lot is improved on one street, the amount that may be charged against the lot for improving the other street is to be estimated on its value after both streets have been improved. In other words, if the value of a corner lot after the improvement of A. street upon which it abuts is \$600, then it may be assessed for the improvement of this street \$300; and if the improvement of B. street which it also abuts will increase its value \$200, then its value for the purpose of estimating the charge that may be put on it for the improvement of B. street is to be estimated at \$800."

PARTIAL EXEMPTION OF CORNER LOTS

A provision of a statute of Pennsylvania exempted the owners of corner lots along one side of which water pipes were laid from assessment for the cost of pipes subsequently laid along the other street for a length of fifty feet. Construing this provision, the Pennsylvania Supreme Court said: "The legislature does not assign its reason for distinguishing between corner lots and others. But it is presumed it was supposed that the owners of the corner lot had been at expense in procuring the water in front, which would make it unreasonable that they should be assessed for laying other pipes at right angle the whole depth of their lots. Fifty feet, therefore, were allowed them free from assessment, beyond which the property was to be assessed." *Commissioners of Spring Garden vs. Smith*, 15 Serg. & R. 160.

And where a statute provided for a payment for water which has been applied for and intro-

duced into the premises of abutting owners from pipes to be constructed in the streets, and an owner of a corner lot only applied for the water on one front, he was held not liable for a pipe on the other front, the water from which he did not use. Baker vs. Gartside, 86 Pa. St. 498.

In Newell vs. Bristol, 78 Connecticut 571, it was held that a property was not a corner lot within a borough rule allowing a certain exemption where a sewer was laid on two frontages of a corner lot, the property abutting on a street which ran north along the east side of the lot a short distance and then turned to the west at an obtuse angle.

It may be said generally that the cost of paving street intersections is not usually thrown upon the corner lots by legislative bodies, and, unless the statute very clearly adopts such a method, the courts, no doubt because of the greater burdens already thrown on corner lots for the paving of both streets, will usually put a different construction on the act.

Federal Good Roads Bill a Law

On June 22 the President signed the Federal Good Roads Bill. This appropriates \$75,000,000 for Federal Aid for each of the next two years and also \$15,000,000 for construction of roads in the several forest reservations. If the states do as well as during the past two years, this will mean a continuation of the annual expenditure of \$1,000,000,000 for roads.

County Highway Paving Statistics

Supplementing Tables published in the May issue by information from questionnaires received since they were compiled

County Highway Appropriations

Amount Spent on Highways in 1925 Under County or State Supervision

| County | County Appropriations | State Appropriations | Federal Appropriations | Other Appropriations | Total amount available for 1926 |
|--------------------|-----------------------|----------------------|------------------------|----------------------|---------------------------------|
| Arizona: | | | | | |
| Gila | \$349,682 | \$32,500 | \$34,000 | ..... | \$136,000 |
| Greenlee | 60,000 | 11,000 | 35,000 | ..... | 207,175 |
| Pinal | 107,175 | 100,000 | ..... | ..... | ..... |
| California: | | | | | |
| Stanislaus | 60,000 | ..... | ..... | ..... | 80,000 |
| Colorado: | | | | | |
| Baca | 20,000 | 20,000 | ..... | ..... | 40,000 |
| Delaware: | | | | | |
| Kent | 300,000 | 300,000 | ..... | ..... | 75,000 |
| Florida: | | | | | |
| Manatee | 400,000 | 100,000 | ..... | ..... | 4,000,000 |
| Saint Lucie | 171,000 | 160,000 | ..... | \$16,700 | 1,195,000 |
| Idaho | | | | | |
| Boise | 34,000 | ..... | 73,000 | ..... | 60,000 |
| Illinois: | | | | | |
| Iroquois | 100,000 | ..... | ..... | ..... | 80,000 |
| Marion | ..... | ..... | ..... | ..... | 60,000 |
| Mason | 54,000 | 104,000 | ..... | ..... | 300,000 |
| Monroe | 30,000 | ..... | ..... | ..... | 22,000 |
| Schuyler | 42,000 | 300,000 | ..... | ..... | 400,000 |
| Shelby | 43,000 | 1,200,000 | ..... | 100,000 | ..... |
| Vermilion | 20,000 | 330,000 | ..... | ..... | 10,000 |
| Iowa: | | | | | |
| Audubon | 30,000 | ..... | ..... | ..... | 100,000 |
| Black Hawk | 66,580 | 17,052 | ..... | ..... | 95,750 |
| Buchanan | 46,000 | ..... | 30,000 | ..... | ..... |
| Bureau Vista | ..... | 80,000 | 20,000 | ..... | 120,000 |
| Carroll | 130,000 | 80,000 | ..... | ..... | 180,000 |
| Clarke | 104,000 | 20,000 | ..... | ..... | 132,000 |
| Gordon | 65,000 | 150,000 | 30,000 | ..... | 225,000 |
| Clayton | ..... | ..... | ..... | ..... | ..... |
| Dallas | 183,000 | 81,000 | ..... | 127,000 | 150,000 |
| Guthrie | 80,000 | ..... | ..... | ..... | 705,000 |
| Johnson | 154,411 | 103,862 | 2,672 | ..... | 125,000 |
| Osceola | 20,000 | 60,000 | ..... | ..... | ..... |
| Pocahontas | 210,672 | 114,218 | 2,537 | 224,565 | 130,000 |
| Winnebago | 130,000 | 125,000 | ..... | ..... | 180,000 |
| Woodbury | 121,432 | ..... | ..... | ..... | ..... |
| Kansas | | | | | |
| Greeley | 5,500 | ..... | ..... | ..... | 30,000 |
| Sheridan | 20,000 | 20,000 | ..... | ..... | 75,000 |
| Stevens | 7,000 | ..... | ..... | ..... | ..... |
| Michigan: | | | | | |
| Crawford | 8,000 | 15,000 | ..... | ..... | 31,000 |
| Gladwin | 13,557 | 8,717 | ..... | ..... | 80,000 |
| Hillsdale | 120,500 | 3,000 | 90,000 | ..... | 1,900,000 |
| Lake | 120,500 | 17,000 | ..... | ..... | 30,000 |
| Lapeer | 120,500 | 10,000 | 20,000 | ..... | 30,000 |
| Macosta | 26,904 | 48,248 | ..... | ..... | 80,000 |
| Shiawassee | 204,976 | ..... | ..... | ..... | ..... |

| | | | | | |
|-----------------------|---------|---------|---------|---------|-----------|
| Tennessee: | | | | | |
| Grundy | ..... | 70,000 | ..... | ..... | 60,000 |
| Hardeman | ..... | ..... | ..... | ..... | 50,000 |
| Texas: | | | | | |
| Cameron | 100,000 | 45,000 | ..... | ..... | ..... |
| Harrison | 55,000 | 38,000 | ..... | ..... | 1,000,000 |
| Jones | ..... | ..... | ..... | ..... | 250,000 |
| Kent | 60,000 | 3,000 | ..... | ..... | ..... |
| Utah: | | | | | |
| Sevier | 10,000 | 10,000 | 40,000 | ..... | 150,000 |
| Tooele | ..... | 100,000 | 300,000 | ..... | 200,000 |
| Virginia: | | | | | |
| Buchanan | 360,000 | 2,000 | 165,000 | ..... | 543,500 |
| Fairfax | 9,500 | 181,000 | ..... | 160,000 | 20,000 |
| Mathews | 15,000 | 4,000 | ..... | ..... | 8,000 |
| New Kent | 6,000 | 40,000 | ..... | ..... | 35,000 |
| Northampton | ..... | ..... | ..... | ..... | 60,000 |
| Smyth | ..... | ..... | ..... | ..... | ..... |
| Washington: | | | | | |
| Klickitat | 125,000 | ..... | ..... | ..... | 140,000 |
| West Virginia: | | | | | |
| Barbour | 350,000 | 145,000 | ..... | 205,000 | 600,000 |
| Monroe | 30,000 | 200,000 | ..... | ..... | ..... |
| Wisconsin: | | | | | |
| Jefferson | 115,140 | 2,889 | ..... | ..... | 400,000 |
| Marquette | 81,759 | 72,418 | ..... | 12,240 | 222,569 |
| Oneida | ..... | ..... | 25,000 | ..... | 216,662 |
| Polk | 125,000 | 55,000 | ..... | 45,000 | 180,000 |
| Rusk | 327,707 | ..... | ..... | ..... | ..... |
| Sauk | 160,591 | 46,027 | ..... | ..... | 194,000 |
| Taylor | 370,000 | ..... | ..... | ..... | 550,000 |
| Trempealeau | ..... | ..... | ..... | ..... | 200,000 |
| Walworth | ..... | ..... | ..... | ..... | ..... |

Shiawassee

204,076

Walworth

200,000

Minnesota:

| | | | |
|---------|---------|--------|---------|
| Becker | 17,366 | 16,900 | 84,000 |
| Douglas | 72,389 | 18,553 | 90,000 |
| Meeker | ..... | ..... | 175,000 |
| Scott | 84,319 | 20,000 | 130,000 |
| Waseca | 120,000 | ..... | 130,000 |

Missouri:

| | | | |
|-------------|---------|---------|---------|
| Barry | 58,000 | ..... | 59,000 |
| Buchanan | 250,000 | ..... | 100,000 |
| Cooper | 75,000 | 360,000 | 195,000 |
| Jasper | ..... | ..... | 12,600 |
| Oregon | 12,700 | ..... | 75,000 |
| Ozark | 6,452 | ..... | 30,000 |
| Pettis | ..... | ..... | 120,000 |
| St. Charles | 281,168 | ..... | ..... |
| Shelby | 29,750 | 90,000 | ..... |
| Worth | 125,000 | ..... | ..... |

Montana:

| | | | |
|-----------|--------|-------|---------|
| Fergus | 57,500 | 2,565 | 135,000 |
| Roosevelt | 18,000 | ..... | 38,000 |

Nebraska:

| | | | |
|----------|-------|--------|-------|
| Franklin | | 50,000 | |
|----------|-------|--------|-------|

New Jersey:

| | | | |
|--------|---------|---------|-------|
| Essex | 945,565 | 110,000 | ..... |
| Morris | 605,000 | 129,740 | ..... |

New Mexico:

| | | | |
|------------|--------|-------|--------|
| Rio Arriba | 10,000 | 7,000 | 20,000 |
| San Miguel | 43,160 | 3,841 | ..... |

New York:

| | | | |
|------------|---------|---------|-----------|
| Chautauqua | 775,000 | 350,000 | 1,500,000 |
| Cortland | 196,000 | 31,100 | 300,000 |
| Jefferson | 300,000 | 400,000 | 1,000,000 |
| Lewis | 43,500 | 43,560 | 135,000 |
| Madison | 120,000 | 42,660 | 185,000 |
| Oswego | ..... | ..... | 537,809 |
| Ulster | 126,112 | 110,850 | 340,340 |
| Wayne | 80,000 | 200,000 | 320,000 |
| Yates | 23,070 | 23,070 | 76,170 |

North Carolina:

| | | | |
|-------------|---------|-------|---------|
| Bertie | 67,500 | ..... | 367,000 |
| Iredell | 450,000 | ..... | 400,000 |
| Mecklenberg | 350,000 | ..... | ..... |
| Onslow | 180,000 | ..... | ..... |

Ohio:

| | | | |
|-----------|---------|---------|-----------|
| Ashtabula | 775,000 | 56,000 | 400,000 |
| Carroll | 256,687 | 78,344 | 360,000 |
| Clark | 43,200 | 5,900 | ..... |
| Clinton | 120,000 | 85,000 | 170,000 |
| Coshocton | ..... | ..... | 100,000 |
| Delaware | ..... | ..... | 1,861,000 |
| Fayette | 65,000 | 80,000 | 75,000 |
| Hamilton | 850,000 | 40,000 | ..... |
| Harrison | 35,000 | 30,000 | 20,000 |
| Jefferson | 500,000 | 245,000 | 450,000 |
| Lorain | 300,000 | 100,000 | 350,000 |
| Marion | 230,000 | 79,000 | ..... |
| Scioto | 24,500 | 11,000 | ..... |
| Summit | 520,000 | 115,000 | 1,200,000 |
| Union | 180,000 | 135,000 | 126,000 |
| Warren | 105,000 | 462,110 | 17,872 |

Oregon:

| | | | |
|---------|--------|--------|---------|
| Klamath | 44,000 | 29,000 | 113,000 |
| Wallowa | ..... | ..... | 125,000 |

Pennsylvania:

| | | | |
|--------------|---------|-----------|-------|
| Adams | ..... | 1,133,027 | ..... |
| Centre | 8,965 | ..... | ..... |
| Westmoreland | 579,169 | ..... | ..... |

South Dakota:

| | | | |
|---------|--------|--------|---------|
| Harding | 20,000 | ..... | 20,000 |
| Jackson | 14,549 | ..... | 25,000 |
| Stanley | 14,443 | 3,700 | 115,000 |
| Yankton | 87,000 | 21,000 | ..... |

Miscellaneous Pavements Laid in 1925

| County | Kind of Pavement | Miles constructed during 1925 | Cost | Miles in County at end of 1925 | Average width of improved surface, feet |
|----------------------|-------------------------|-------------------------------|----------|--------------------------------|---|
| Illinois: | | | | | |
| Iroquois | Oiled earth | 145 | \$27,000 | 100 | 10 |
| Shelby | Oiled earth | 100 | 30,000 | ..... | 18 |
| New Jersey: | | | | | |
| Essex | Granite block | 0.73 | 148,211 | 12.09 | 30 |
| ..... | Warrentite-bitulithic | ..... | ..... | 24.10 | 30 |
| ..... | Amiesite | ..... | ..... | 22.46 | 20 |
| ..... | Sheet asphalt | 2.65 | 266,397 | 9.46 | 24 to 40 |
| ..... | Warrentite-bitulithic | ..... | ..... | 13.00 | ..... |
| Morris | Amiesite | 3.25 | 165,000 | 29.50 | ..... |
| ..... | Sheet asphalt | ..... | ..... | 5.20 | ..... |
| ..... | Bit. dressed macadam | ..... | ..... | 73.00 | ..... |
| Ohio: | | | | | |
| Ashtabula | Cinder | 3.0 | 12,000 | 103.0 | 16 |
| Carroll | Cinder | ..... | ..... | 13.37 | 16 |
| Clark | Warrentite-bitulithic | 0.5 | 4,196 | 9.50 | ..... |
| Delaware | Amiesite | ..... | ..... | ..... | ..... |
| Lorain | Sheet asphalt | 1.39 | 25,000 | 9 | 24 |
| Lucas | Sheet asphalt | 6.06 | 364,221 | ..... | ..... |
| ..... | Brick and concrete | 2.83 | 65,000 | ..... | 18 |
| Marion | Sheet asphalt | 22.39 | 237,823 | 3.25 | 16 |
| Summit | Slag, traffic-bound | ..... | ..... | 69.23 | 16 |
| Union | Sheet asphalt | ..... | ..... | 1.64 | 18 |
| Pennsylvania: | | | | | |
| Adams | Surface-treated macadam | 5.0 | 177,000 | 67.8 | 16 |
| Westmoreland | Amiesite | 5.44 | 107,483 | ..... | 16 |
| ..... | Kentucky rock | 8.34 | 249,451 | ..... | 16 |
| Texas: | | | | | |
| Harrison | Sheet asphalt | 16 | 33,400 | 40 | 16 |

Standardizing Construction Equipment

Reports of great savings effected by standardization of construction equipment feature a statement just issued by the Associated General Contractors of America on the cost of machinery purchased by contractors. Within one year, a direct reduction of prices of concrete mixers has been accomplished by elimination of several useless and duplicated types of machines, it is stated. This reduction, declared to be from five to seven percent of prices prevailing twelve months ago, is seen as only the forerunner of the campaign's ultimate results.

The reduction is very important to contractors, for with labor costs steadily rising and prices of materials apparently down close to bed-rock, they are being forced constantly to look for increased efficiency and economy in their mechanical operations.

The formation of the Affiliated Bureau of the A. G. C. came three years ago when leading manufacturers of equipment used by contractors saw the necessity for taking steps to reduce the waste caused by production of a long succession of unnecessary models. Until that time, each manufacturer had been striving to gain advantages over his competitors by periodically placing new models on the market, each change requiring the expenditure of thousands of dollars in changing his plant equipment, which overhead was passed on to builders.

Cement Concrete Paving in 1925

| County | CONCRETE REINFORCED | | | Average width of Improved surface, feet | CONCRETE NOT REINFORCED | | |
|-----------------------|-------------------------------|-----------|--------------------------------|---|-------------------------------|-----------|--------------------------------|
| | Constructed during 1925 Miles | Cost | Total in County at end of 1925 | | Constructed during 1925 Miles | Cost | Total in County at end of 1925 |
| Arizona: | | | | | | | |
| Pinal ..... | .. | .... | .. | .. | .. | .... | 1.25 |
| California: | | | | | | | |
| Stanislaus ..... | .. | .... | .. | .. | .. | .... | 145 |
| Illinois: | | | | | | | |
| Iroquois | 7 3/4 | \$158,000 | 27 | 18 | .. | .... | 73 |
| Mason | 8 | 230,000 | .. | .. | .. | .... | .. |
| Schuyler | 40 | 1,200,000 | 40 | 18 | .. | .... | .. |
| Shelby ..... | .. | .. | .. | .. | .. | .... | .. |
| Iowa: | | | | | | | |
| Black Hawk ..... | .. | .... | 50 | 18 | .. | .... | .. |
| Buchanan ..... | .. | .... | 15 | 16 | .. | .... | .. |
| Johnson ..... | .. | .... | 3.5 | 18 | .. | .... | .. |
| Michigan: | | | | | | | |
| Gladwin ..... | .. | .... | 1 | 26 | .. | .... | .. |
| Hillsdale ..... | .. | .... | .. | .. | .. | \$30,000 | .. |
| Huron ..... | .. | .... | .. | .. | 3 | 93,262 | 18 |
| Shiawassee ..... | .. | .... | .. | .. | 5 | .. | 24 |
| Missouri: | | | | | | | |
| Buchanan ..... | .. | .... | .. | .. | .. | .... | 7 |
| Cooper ..... | .. | .... | .. | .. | 12 | 360,000 | .. |
| Jasper | .. | 2,079,000 | 66 | 18 | .. | .... | .. |
| Pittsburg | 14 | 500,000 | 14 | 18 | .. | .... | .. |
| St. Charles ..... | .. | .... | 27 | .. | .. | .... | 1 |
| New Jersey: | | | | | | | |
| Essex | 6.86 | 495,156 | 10.54 | 24 | .. | .... | .. |
| Morris | 1.10 | 90,000 | 11 | .. | .. | .... | 1.70 |
| New York: | | | | | | | |
| Chautauqua | 22 | 975,000 | .. | 18 | .. | .... | .. |
| Cortland ..... | .. | .... | .. | 18-24-30 | .. | .... | .. |
| Jefferson | 8 | 240,000 | 52 | 16 and 18 | .. | .... | .. |
| Lewis | .07 | .. | 1.67 | 16 | .. | .... | .. |
| Madison | .. | .. | .. | .. | 5 | 60,000 | 13 |
| Ulster | .36 | 13,000 | .36 | 14 | .. | .... | 10 & 16 |
| Wayne | 2.5 | .. | .. | 18 | 1.8 | .. | 10 |
| Ohio: | | | | | | | |
| Ashtabula | 12 | 403,000 | 31.92 | 10 and 16 | .. | .... | 19.26 |
| Clark ..... | .. | .... | 14.80 | 16 | .. | .... | 10 & 16 |
| Delaware ..... | .. | .... | .. | .. | .. | .... | 23.37 |
| Hamilton ..... | .. | .... | .. | .. | 5 | .. | 48.72 |
| Jefferson | .. | .. | 11.31 | 18-20 | .. | .... | 16 |
| Lorain | 3 | 75,000 | .. | .. | .. | .... | .. |
| Lucas | .60 | 30,328 | 82 | 21 | .. | .... | .. |
| Summit | 10.10 | 359,363 | 47.42 | 18 | .. | .... | .. |
| Union | 9 | 270,000 | .. | .. | .. | .... | .. |
| Warren ..... | .. | .... | .. | .. | .. | .... | 3.1 |
| Pennsylvania: | | | | | | | |
| Adams | 8.8 | 349,027 | 48.9 | 16 to 18 | .. | .... | .. |
| Indiana | 26 | 1,144,000 | 120 | 16 to 18 | .. | .... | .. |
| Westmoreland | 8.03 | 355,996 | 37.53 | 16 | .. | .... | .. |
| Texas: | | | | | | | |
| Cameron | 2 | 50,000 | 40 | .. | .. | .... | .. |
| Virginia: | | | | | | | |
| Fairfax | 13 | 450,000 | .. | .. | .. | .... | .. |
| Northampton | 5 1/2 | .. | .. | .. | .. | .... | .. |
| West Virginia: | | | | | | | |
| Barbour ..... | .. | .... | .. | .. | 2 | 80,000 | 2 |
| Wisconsin: | | | | | | | |
| Jefferson | 40 | .. | .. | .. | 40 | 2,000,000 | .. |
| Sauk | 6 | .. | 9 | 18 | .. | .... | .. |
| Walworth | 4 | 120,000 | 134 | 18 | .. | .... | .. |

Improved Methods in California Highway Construction

The first contract awarded by the California Highway Commission was for the construction of 5.4 miles of pavement twenty-four feet wide in San Mateo County, awarded on July 23, 1912, and completed on June 26th, 1913. This section has recently been rebuilt and this suggests a comparison between the methods of thirteen years ago and those of 1926.

The first contract provided for a cement concrete base mixed one cement, 3 sand and 6 gravel, to be kept moist for not less than five days after placing. On this was laid sheet asphalt to a thickness of one to one and one-half inches, the average penetration being seventy degrees. Today, the California specifications for concrete pavements provide for one part cement, 1.8 sand and 3.6 rock, proportioned by the most exact methods and with the amount of water carefully

determined and measured. The pavements are cured for fourteen days by ponding. Sheet asphalt surfaces are no longer used and asphalt concrete surface material must have a penetration of forty to fifty degrees.

In spite of the inferiority of the original specifications as compared to present ways, the first pavement held up remarkably well under the extremely heavy traffic which it has carried and it was not so much the condition or the pavement as the necessity of widening it to forty feet that caused its reconstruction this year.

In the reconstruction, 8 foot cement concrete shoulders were placed on each side of the existing pavement, eight inches thick in the center and ten inches at the edges and extending 2 1/2 inches above the surface of the existing pavement. The old pavement was covered with asphalt concrete 2 1/2 inches thick at the edges and decreasing to about one inch in the center to eliminate the excessive crown of the old road.

Gravel Roads in 1925

| County | Constructed during 1925 Miles | Cost | Total in County at end of 1925 | Average width of improved surface, feet |
|------------------------|----------------------------------|-----------|--------------------------------|---|
| Arizona: | | | | |
| Gila | 27 | \$65,000 | 275 | 20 |
| Greenlee .. | .. | .... | 134 | 20 |
| Pinal ..... | .. | .... | 199 | 20 |
| California: | | | | |
| Stanislaus .. | 200 | 100,000 | 500 | 16 |
| Florida: | | | | |
| Manatee ... | .. | .... | 40 | 16 |
| Illinois: | | | | |
| Iroquois ... | 3½ | 36,118 | 30 | 14 |
| Pulaski | 3 | 3,000 | .... | .. |
| Iowa: | | | | |
| Black Hawk .. | 11.5 | 15,580 | 79 | 26 |
| Buena Vista .. | 20 | .... | 196 | 26 |
| Carroll | 14 | 14,000 | 55 | .. |
| Cerro Gordo .. | 16½ | 27,225 | 60 | 20 |
| Clayton | 9 | 30,000 | .... | .. |
| Dallas | 35 | 75,000 | 337 | 26 |
| Guthrie | 3.0 | 3,000 | 4 | 24 |
| Osceola | 8 | 12,000 | 56 | 24 |
| Pocahontas .. | .. | .... | 160 | 26 |
| Winneshiek .. | .. | .... | 60 | 26 |
| Woodbury .. | 2.50 | 5,979 | 17.67 | 20 |
| Michigan: | | | | |
| Cranford .. | 3 | 9,000 | 52 | 16 |
| Gladwin | ..90 | 5,828 | 88 | 26 |
| Hillsdale .. | 15 | 120,000 | 300 | 12 |
| Huron | 29 | 261,244 | 460 | 9 |
| Lake | 5 | 30,000 | .. | 16 |
| Luce | 2½ | 8,000 | 21¾ | .. |
| Mecosta | 12 | 33,802 | 297 | 9, 12, 16 |
| Shiawassee .. | 7 | .... | 336 | 9 |
| Minnesota: | | | | |
| Becker ..... | .. | .... | 16.5 | .. |
| Douglas | 13.7 | 21,037 | 104.85 | 24 |
| Scott | 10 | 16,086 | 82 | .. |
| Waseca | 16.9 | 18,000 | 102.6 | 24 |
| Missouri: | | | | |
| Barry | 10 | .... | 20 | .. |
| Jasper | 38 | 2,200 | 730 | 18 |
| Oregon ..... | .. | .... | 100 | 20 |
| Pettis | 10 | 17,458 | 130 | .. |
| St. Charles .. | 10.75 | .... | 254.35 | 10 |
| Worth | 5 | 20,000 | .. | .. |
| Montana: | | | | |
| Fergus | 4¼ | 7,025 | 23 | 22 |
| Roosevelt .. | .. | .... | 30 | 22 |
| Nevada: | | | | |
| Lander | 6½ | .... | .. | .. |
| New Mexico: | | | | |
| Rio Arriba .. | .. | .... | 100 | 12 |
| New York: | | | | |
| Chautauqua .. | 14 | .... | .. | .. |
| Jefferson | 10 | 20,000 | 120 | 10 |
| Oswego ..... | .. | .... | 278 | .. |
| Wayne | 75 | 38,500 | .. | .. |
| North Carolina: | | | | |
| Mecklenburg .. | 10 | .... | .. | .. |
| Ohio: | | | | |
| Ashtabula .. | .. | .... | 68.3 | 12 |
| Carroll | 4 | 20,000 | 4 | 9 |
| Clinton ..... | .. | .... | 415.78 | .. |
| Coshocton .. | 4.4 | 23,929 | .. | 16 |
| Delaware ..... | .. | .... | 161 | .. |
| Hamilton ..... | .. | .... | 61.32 | .. |
| Marion ..... | .. | .... | 92 | 12 |
| Summit | 1.71 | 8,970 | 8.73 | .. |
| Union ..... | .. | .... | 689 | 18 |
| Warren | 9 | 27,000 | 6350 | .. |
| Oregon: | | | | |
| Klamath Falls .. | 10 | 39,000 | 10 | .. |
| Wallowa | 3 | 1,800 | 150 | 20 |
| South Dakota: | | | | |
| Jackson ..... | .. | .... | 20 | 24 |
| Stanley | 8 | 9,600 | 12 | .. |
| Yankton | 22 | 34,000 | 105 | 20 |
| Tennessee: | | | | |
| Bradley | 60 | .... | .. | .. |
| Texas: | | | | |
| Harrison | 15 | .... | 75 | 12 |
| Jones | 80 | 240,000 | .. | .. |
| Utah: | | | | |
| Sevier | 10 | .... | 90,000 | 26 |
| Tooele | 40 | 400,000 | .. | .. |
| Virginia: | | | | |
| Fairfax | 2 | 30,000 | .. | .. |
| New Kent | 15 | 18,000 | 15 | 30 |
| Northampton .. | 10 | 2,000 | 175 | 30 |
| Washington: | | | | |
| Klickitat | 5 | 20,000 | .. | .. |
| West Virginia: | | | | |
| Barbour | 8.3 | 107,000 | 34.5 | 15 |
| Wisconsin: | | | | |
| Jefferson | 700 | 2,800,000 | .. | .. |
| Marquette | 24 | 35,123 | .. | .. |
| Oneida | 6¾ | 16,000 | .. | 30 |
| Polk | 17½ | 622,037 | .. | 24 |
| Rusk | 26 | 22,400 | 95 | .. |
| Sauk | 7 | 27,043 | 275 | 18 |
| Taylor | 24¼ | 23,132 | .. | 15 |
| Walworth | 20 | 60,000 | 175 | 20 |

Sand Clay Roads in 1925

| County | Constructed during 1925 Miles | Cost | Total in County at end of 1925 | Average width of improved surface, feet |
|------------------------|----------------------------------|---------|--------------------------------|---|
| Florida: | | | | |
| Jefferson | 25 | .... | .. | .. |
| Minnesota: | | | | |
| Becker ..... | .. | .... | 2.4 | .... |
| Missouri: | | | | |
| Oregon ..... | .. | .... | 200 | 15 |
| North Carolina: | | | | |
| Onslow ..... | .. | .... | 50 | 24 |
| Ohio: | | | | |
| Hamilton ..... | .. | .... | 23.35 | .. |
| Virginia: | | | | |
| Northampton .. | 10 | \$2,000 | 175 | 30 |
| Wisconsin: | | | | |
| Jefferson | 80 | 160,000 | .... | .... |

Top Soil in 1925

| County | Constructed during 1925 Miles | Cost | Total in County at end of 1925 | Average width of improved surface, feet |
|------------------------|----------------------------------|-------|--------------------------------|---|
| Michigan: | | | | |
| Luce ..... | .. | .... | 5 | .. |
| Missouri: | | | | |
| Oregon ..... | .. | .... | 200 | 15 |
| Ozark | 30 | .... | .... | .... |
| North Carolina: | | | | |
| Mecklenburg ... | 10 | .... | .... | .... |
| Ohio: | | | | |
| Warren ..... | .. | .... | 101 | .... |
| Texas: | | | | |
| Jones | 420 | .... | .... | .... |
| West Virginia: | | | | |
| Monroe | 9 | \$170 | 30 | 26 |
| Wisconsin: | | | | |
| Jefferson | 10 | 1,000 | .... | .. |
| Oneida | 78 | 500 | .... | 24 |

Graded Roads Constructed in 1925

| County | Constructed during 1925 Miles | Cost | Total in County at end of 1925 |
|--------------------|----------------------------------|----------|--------------------------------|
| Arizona: | | | |
| Gila | 34 | \$34,000 | 65 |
| Greenlee ..... | .. | .... | 48 |
| Pinal ..... | .. | .... | 626.3 |
| California: | | | |
| Stanislaus | 50 | 5,000 | 800 |
| Colorado: | | | |
| Baca | 50 | 10,000 | 550 |
| Florida: | | | |
| Jefferson | 500 | .... | .. |
| Manatee | 50 | 1,500 | 100 |
| Saint Lucie | 12 | 10,000 | 104 |
| Idaho: | | | |
| Boise | 4.7 | 73,000 | 24 |
| Illinois: | | | |
| Iroquois | 10 | .... | .. |
| Marion | 300 | .... | .. |
| Monroe | 12 | 8,000 | 80 |
| Schuyler | 4 | 98,000 | .. |
| Shelby | 60 | 3,800 | 60 |
| Iowa: | | | |
| Black Hawk | 18 | 27,875 | 60.5 |
| Buena Vista | 26 | .... | .. |
| Carroll | 10 | 42,000 | .. |
| Cerro Gordo | 5 | .... | .. |
| Clarke | 8 | 175,000 | 82 |
| Dallas | 48 | 42,000 | 40 |
| Guthrie | 4.0 | 4,000 | 8.0 |
| Johnson | 5.05 | 46,926 | 75.17 |
| Osceola | 7 | 12,000 | 25 |
| Pocahontas | 20 | 46,505 | 23 |
| Winneshiek | 14 | 100,000 | .. |
| Woodbury | 16.09 | 33,608 | 31.58 |
| Kansas: | | | |
| Geeley | 76 | 2,700 | 106 |
| Michigan: | | | |
| Shiawassee | 3 | .... | .. |
| Minnesota: | | | |
| Becker | 9.6 | 39,200 | 29.2 |
| Douglas | 10.25 | 26,500 | 36.63 |
| Scott | 10.3 | 32,717 | 9.5 |
| Waseca | 6.6 | 17,900 | 39.7 |
| Missouri: | | | |
| Barry | 20 | .... | 282 |
| Buchanan | 20 | 70,000 | 110 |
| Cooper | 700 | 75,000 | .. |
| Pettis ..... | .. | .... | 1100 |
| Pittsburg | 8 | .... | .. |
| St. Charles | 23 | .... | 23 |
| Shelby ..... | .. | .... | 600 |
| Worth | 10 | 70,000 | .. |
| Montana: | | | |
| Fergus | 4 | 1,200 | 825 |
| Roosevelt | 30 | 3,500 | .. |

Brick Pavements Laid in 1925

| County | Constructed during 1925 | | Total in County at end of 1925 | County | Constructed during 1925 | | Total in County at end of 1925 | Average width of improved surface, feet |
|------------------------|-------------------------|---------|--------------------------------|----------------------|-------------------------|-----------|--------------------------------|---|
| | Miles | Cost | | | Miles | Cost | | |
| Nebraska: | | | | Iowa: | | | | |
| Franklin | 9.54 | 100,000 | 45 | Black Hawk .. | .. | .. | 4 | 18 |
| Schuman | 35 | 3,500 | 125 | New Jersey: | | | | |
| Nevada: | | | | Morris | .. | .. | 73 | .. |
| Lander | 2 | .. | .. | New York: | | | | |
| New Jersey: | | | | Jefferson ... | .. | .. | 3 | 16 |
| Morris | .. | .. | 40 | Ohio: | | | | |
| New Mexico: | | | | Ashtabula .. | .. | .. | 99.40 | 10 & 16 |
| Rio Arriba | 5 | 3,000 | 100 | Carroll | .. | .. | 16.81 | .. |
| New York: | | | | Clinton | .. | .. | 11.16 | .. |
| Chautauqua | 7.6 | .. | .. | Delaware .. | .. | .. | 24.49 | .. |
| Oswego | 25 | 5,000 | .. | Hamilton .. | .. | .. | 5.71 | .. |
| North Carolina: | | | | Lucas | 2.64 | \$168,925 | 8 | 36 |
| Mecklenburg | 6 | .. | 150 | Marion | .. | .. | 7.51 | 15 |
| Onslow | 25 | .. | .. | Scioto | 3 | 142,000 | .. | .. |
| Ohio: | | | | Summit | 2.01 | 44,063 | 69.66 | 16 |
| Ashtabula | 1.0 | 2,700 | .. | Wyandot .. | 6½ | 226,019 | 12 | .. |
| Carroll | 2 | 22,987 | 2 | Pennsylvania: | | | | |
| Harrison | 5 | 10,000 | 576 | Westmoreland | 0.16 | 9,274 | 47.02 | 16 |
| Lucas | .. | .. | 200 | Wisconsin: | | | | |
| Marion | .. | .. | .. | Sauk | .. | .. | 2 | 25 |
| Oregon: | | | | | | | | |
| Klamath | 11½ | 31,500 | 43 | | | | | |
| Wallowa | 19 | 60,000 | 200 | | | | | |
| Pennsylvania: | | | | | | | | |
| Adams | .. | .. | 125 | | | | | |
| South Dakota: | | | | | | | | |
| Harding | 50 | 7,000 | 410 | | | | | |
| Jackson | 14.5 | 2,175 | 290.5 | | | | | |
| Stanley | 46 | 14,443 | 154 | | | | | |
| Yankton | 27 | 52,000 | .. | | | | | |
| Tennessee: | | | | | | | | |
| Grundy | 5 | 70,000 | .. | | | | | |
| Hardeman | 800 | .. | .. | | | | | |
| Texas: | | | | | | | | |
| Cameron | 300 | 30,000 | 500 | | | | | |
| Harrison | .. | .. | 625 | | | | | |
| Jones | 420 | .. | .. | | | | | |
| Kent | 45 | 60,000 | 95 | | | | | |
| Sevier | 30 | .. | .. | | | | | |
| Virginia: | | | | | | | | |
| Buchanan | 30 | 360,000 | 30 | | | | | |
| Mathews | 15 | 250 | 150 | | | | | |
| New Kent | 150 | 3,750 | .. | | | | | |
| Washington: | | | | | | | | |
| Klickitat | 13 | 18,000 | .. | | | | | |
| West Virginia: | | | | | | | | |
| Barbour | 20 | .. | .. | | | | | |
| Monroe | 9 | 170 | .. | | | | | |
| Wisconsin: | | | | | | | | |
| Jefferson | 10 | .. | .. | | | | | |
| Marquette | 23 | 36,400 | .. | | | | | |
| Oneida | 15½ | 27,817 | .. | | | | | |
| Polk | .. | 16,720 | .. | | | | | |
| Rusk | 56 | 9,200 | 220 | | | | | |
| Sauk | 16 | 393,585 | 25 | | | | | |
| Taylor | 15 | 22,464 | .. | | | | | |

Bituminous Concrete Laid in 1925

| County | Constructed during 1925 | | Total in County at end of 1925 | Average width of improved surface, feet |
|----------------------|-------------------------|-----------|--------------------------------|---|
| | Miles | Cost | | |
| California: | | | | |
| Stanislaus .. | .. | .. | 4 | 18 |
| Florida: | | | | |
| Manatee ... | 2 | .. | .. | .. |
| New Jersey: | | | | |
| Essex | .. | .. | 126.93 | 30 |
| Morris | .. | .. | 11.40 | .. |
| Ohio: | | | | |
| Clinton | .. | .. | 11.16 | .. |
| Hamilton .. | .. | .. | 4.81 | .. |
| Marion | .. | .. | 2 | 16 |
| Summit | 11.12 | \$365,515 | 53.62 | .. |
| Wyandot .. | .. | .. | 10 | .. |
| Pennsylvania: | | | | |
| Adams | 1.2 | 30,000 | 5 | 16 |
| Westmoreland* | 2.00 | 38,499 | 22.12 | 16 |

*Strictly County roads only.

Bituminous Macadam Laid in 1925

| County | Constructed during 1925 | | Total in County at end of 1925 | Average width of improved surface, feet |
|------------------------|-------------------------|----------|--------------------------------|---|
| | Miles | Cost | | |
| California: | | | | |
| Stanislaus .. | 2 | .. | 25 | 16 |
| Florida: | | | | |
| Saint Lucie. 15 | \$241,000 | 67 | 16 | .. |
| Michigan: | | | | |
| Huron | .. | 4 | .. | .. |
| Luce | 4 | 65,000 | 22 | .. |
| Missouri: | | | | |
| Buchanan .. | .. | .. | 20 | .. |
| Pettis | .. | .. | 23 | .. |
| St. Charles.. | .. | .. | 2 | .. |
| New Jersey: | | | | |
| Morris | .. | .. | 2 | .. |
| New York: | | | | |
| Chautauqua. ½ | 25,000 | .. | 18 | .. |
| Jefferson ... | .. | 738 | 10 & 16 | .. |
| Oswego | .. | 279 | 12 | .. |
| Ulster | 3.53 | 26,574 | 12 | .. |
| Wayne | 3 | .. | .. | .. |
| North Carolina: | | | | |
| Iredell | .. | .. | 12 | 18 |
| Ohio: | | | | |
| Ashtabula .. | .. | 11.15 | 9 | .. |
| Carroll | 10 | 60,000 | 34.98 | 9 & 18 |
| Clinton | .. | .. | 83.40 | .. |
| Delaware | 3.8 | 26,196 | 24.42 | 28 |
| Hamilton | .. | .. | 63.21 | .. |
| Harrison | 4 | 10,000 | 11.4 | 12 |
| Jefferson | 10.78 | 171,200 | 144.61 | 10 |
| Lorain | 1 | 13,000 | .. | .. |
| Lucas | 1.70 | 23,652 | 135 | .. |
| Marion | 15 | 75,000 | .. | 14 |
| Summit | 3.27 | 67,913 | 4.93 | .. |
| Warren | 4 | 92,422 | 21.3 | 16 & 18 |
| Wyandot | 10 | 65,225 | .. | .. |
| Pennsylvania: | | | | |
| Indiana | .. | .. | 20 | 16 |
| Westmoreland | .. | .. | 8.63 | 16 |
| Virginia: | | | | |
| Fairfax | 1 | 12,500 | .. | .. |
| Smyth | 3 | 8,000 | 50 | 18 |
| West Virginia: | | | | |
| Monroe | 9 | .. | .. | 16 |
| California: | | | | |
| Stanislaus .. | 6 | \$50,000 | 8 | 16 |
| Michigan: | | | | |
| Huron | 6 | 120,827 | 17 | 16 |
| Missouri: | | | | |
| Buchanan .. | .. | .. | 10 | .. |
| Pettis | .. | .. | 17 | .. |
| St. Charles.. | 1½ | .. | 11 | .. |
| New Jersey: | | | | |
| Essex | 1.4 | 17,822 | 1.4 | 16 |
| Morris | 7 | 175,000 | 15 | 18 |
| New York: | | | | |
| Chautauqua. 12.5 | 504,000 | .. | .. | 16 |
| Cortland | 200,000 | 201 | 14 | .. |
| Jefferson | 40 | 60,000 | 410 | 10 & 16 |
| Lewis | 25.96 | .. | 105 | 10 |
| Madison | 14 | 98,000 | 140 | 10 & 16 |
| Oswego | 25.7 | 304,368 | 96.3 | 14 |
| Ulster | 22.01 | 337,140 | 65.26 | 14 |
| Wayne | 10 | .. | .. | .. |
| North Carolina: | | | | |
| Mecklenburg | 4 | .. | .. | 18 |
| Ohio: | | | | |
| Ashtabula .. | 5.29 | 137,000 | 77.49 | 14 |
| Carroll | 4 | 133,700 | 9.84 | 18 |
| Clarke | 3.75 | 108,000 | 26.91 | 18 |
| Delaware | 8.2 | 149,158 | 23.55 | 24 |
| Hamilton | 25 | .. | 420.49 | .. |
| Harrison | 8 | 37,500 | 80.8 | 16 & 18 |
| Jefferson | 18.41 | 156,200 | 97.15 | 10 & 16 |
| Lorain | 17 | 160,000 | .. | .. |
| Lucas | 24.45 | 512,018 | 210 | 18 |
| Marion | 60 | 30,000 | 145 | 12 |
| Summit | 13.85 | 30,299 | 15.73 | .. |
| Union | .. | .. | 38.71 | 18 |
| Warren | 1.67 | 31,160 | 11.9 | 16 |
| Pennsylvania: | | | | |
| Adams | 5 | 176,000 | 9.9 | 16 |
| Virginia: | | | | |
| Fairfax | 7.4 | 203,500 | .. | .. |
| West Virginia: | | | | |
| Barbour | 8.3 | 107,000 | 34.5 | 15 |
| Monroe | 2 | .. | .. | 16 |

Recent Legal Decisions

IMPLIED POWERS OF MUNICIPALITIES

The Florida Supreme Court holds, *Tiberis v. Harper*, 104 So. 853, that "if reasonable doubt exists as to a particular power of a municipality, it should be resolved against the city; but, where the particular power is clearly conferred, or is fairly included in or inferable from other powers expressly conferred, and is consistent with the purpose of the municipality and the powers expressly conferred, the exercise of the power should be resolved in favor of the city so as to enable it to perform its proper functions of government."

EXTENSION OF MUNICIPALITY'S TERRITORY BY VOTE

The Florida Supreme Court holds, *Nabb v. Andreu*, 104 So. 591, that the authority of the State Legislature under section 8 of article 8 of the State Constitution, to establish and abolish municipalities includes the power to annex by legislative enactment, contiguous territory to an existing municipality, effective upon an affirmative vote at an election therein provided for, or without such an election.

Under the act providing for the extension of the territory of the city of St. Augustine by vote of a majority of the qualified electors of the city and those of the "entire territory proposed to be included" within the city's corporate limits, it is held that the vote required is a majority vote of the qualified city electors and of those of the entire territory proposed to be included (not annexed), which comprehends the territory within the existing city and the territory proposed to be annexed, voting in the ratification election.

RECOVERY FOR WORK DONE UNDER VOID CONTRACT FOR REMOVING HARDPAN

The Washington Supreme Court holds, *Besoloff v. Whatcom County*, 233 Pac. 284, that where an oral contract was made with a road contractor for the removal of hardpan when it was found the work was not within his road contract, the contract was void because not awarded to the lowest and best responsible bidder, as required by the Donohue Road Law; but, the county having accepted and received the benefit of the work, the contractor was held entitled to recover the reasonable value of removing the hardpan.

APPORTIONMENT OF EXPENSE OF CONSTRUCTION OF CROSSING OF RAILROAD BY STREET

The Missouri Supreme Court holds, *State v. Public Service Commission* (Kansas City intervening), 272 S. W. 957, that the Commission has only the powers conferred on it under the Public Service Commission Law. Under section 50 of that act the Commission is given the exclusive power to prescribe the manner, including the particular point of crossing, the terms of installation, operation, maintenance, apportionment of expenses, use and protection of each crossing of a street by a railroad or vice versa. Under this section, it is held that a rail-

road and a municipality cannot, by agreement, determine the manner of the crossing, because the paramount interest of the public is at stake. But there is no reason why they may not agree upon the apportionment of the expenses. If either assumes the whole burden, or if they agree upon the proportionate part each shall pay, there is no reason for submitting the question of apportionment to the Commission. Where no apportionment of expenses in any proper sense was sought, but the city insisted upon the railroad paying all the expenses of construction and maintenance of the crossing of the railroad by a street on the ground that it had bound itself by contract so to do, it was held to be for the Commission to prescribe the manner, including the particular point of crossing, leaving questions as to the construction and enforcement of the alleged contract for determination by the courts.

UNUSED CITY DUMPING GROUND HELD EXEMPT FROM TAXATION

The Arkansas Supreme Court holds, *Hudgins v. City of Hot Springs*, 270 S. W. 594, that property purchased and used for several months by the city as a dumping ground for refuse was exempt from taxation as property used for a public purpose although its use had been discontinued because the road to it had become impassable.

ACCEPTANCE BY CITY OF SOME SIDEWALKS, BEFORE OTHERS ARE COMPLETED, HELD PROPER

The Kentucky Court of Appeals holds, *Orr v. Mann*, 270 S. W. 491, that where an ordinance authorizing a sidewalk required bids on each street to be stated separately, it was immaterial that the accepted bid stated a single price for all the sidewalks, where it was not claimed that parties objecting to the validity of the proceedings had been prejudiced by the work being contracted for as a whole.

It was held proper for the city council to receive the work on completed streets and levy special assessments therefor before the work on other streets had been completed. The court said: "To hold, where work of several streets is contracted for, that work upon all must be completed before the work upon any can be received or paid for, would result in a hardship on the contractor and no advantage to the property owner, and in all contracts thereafter let, men of limited means would be deterred from bidding, as they would perhaps be unable to obtain the money to pay for the work, if the work on no street could be received and paid for until that on all had been completed."

DEFINITION OF "BOULEVARD"

The Kentucky Court of Appeals holds, *Newbold v. Brotzge*, 272 S. W. 755, that a street is not a "boulevard" within the meaning of Ky. St. sec. 2739, g 37, as to the right of way of vehicles at the intersection of boulevards, etc., unless it is so designated by ordinance. The court says that an avenue may be a parkway, or a parkway may be an avenue, but neither of them is necessarily a boulevard, which

is variously defined as a street of especial width, given a parklike appearance by reserving spaces at the side or centre for shade trees, flowers, seats, etc., and not used for heavy teaming; a broad city avenue, specially designed for pleasure walking or driving, generally planted with trees, often in the centre; a broad promenade or street, etc.

SPECIAL IMPROVEMENT DISTRICT, DECLARED VOID AB INITIO, CANNOT ENTER INTO BINDING OBLIGATIONS

The Arkansas Supreme Court holds, *Davis v. Lawson*, 272 S. W. 646, that a special improvement district within the limits of a city, declared by a court, on direct attack, void ab initio (from the beginning), has no de facto (actual) existence, so as to be able to enter into binding obligations.

LAND HELD BY A STATE IN ANOTHER STATE SUBJECT TO CONDEMNATION FOR STREET PURPOSES

The Tennessee Supreme Court holds, *City of Chattanooga v. State*, 272 S. W. 432, that the state of Georgia, holding land in Tennessee, holds it as such property is held by a corporation or quasi corporation, and the land is subject to condemnation by a city for street purposes under the Tennessee statutes.

OWNER ESTOPPED TO DENY VALIDITY OF STREET ASSESSMENT

The South Carolina Supreme Court holds, *Balentine v. City of Columbia*, 129 S. E. 82, that a landowner may waive or by his conduct estop himself from disputing his liability for an assessment upon his property, even where it has been held to be unconstitutional in respect to other landowners whose property was similarly situated. In this case the owner was held estopped from contesting the validity of a street assessment on the ground that the election as to whether the improvement should be made was not held as required by the statute.

DECREASE IN VALUE OF ABUTTING PROPERTY HELD NOT RESULT OF PAVING

The Georgia Court of Appeals holds, *Southland Inv. Co. v. City of Moultrie*, 129 S. E. 288, that a decrease in the market value of property abutting on a street by reason of the egress and ingress by vehicles to and from the street being made difficult as a result of a park 15½ feet wide having been constructed and left in the middle of the street by the city simultaneously with the laying of the pavement, is not a damage to the property resulting from the laying of the pavement, but is a damage resulting solely from the construction and maintenance of the park in the middle of the street. Such damage, therefore, is not defensive matter to an execution issued against the property for the cost of the pavement.

READVERTISEMENT FOR BIDS ON ABANDONMENT OF STREET IMPROVEMENT CONTRACT

The Arizona Supreme Court holds, *Mosher v. City of Phoenix*, 237 Pac. 173, that where the contractor for a street improvement made a cash deposit and executed a faithful performance bond,

but afterwards, with consent of the city commission, abandoned the contract, the commission was authorized, under Civ. Code 1913, par. 1960, as amended by Laws 1917, c. 52, to re-advertise for bids and award the contract to another contractor. The plaintiff in an action to have the contract made on readvertisement set aside, having made no objection to its award, was held precluded under the statute mentioned from making any objections excepting as to matters directly affecting the jurisdiction of the commission to order the work.

DEDICATION OF RAILROAD CROSSING HELD NOT SUBJECT TO WITHDRAWAL

The Oklahoma Supreme Court holds, *Missouri, K. & T. Ry. Co. v. City of Tulsa*, 237 Pac. 451, that a common carrier which dedicates a part of its right of way in an addition to a city as a street crossing for public use cannot withdraw the privilege after property has been acquired adjacent to and served by the street for which the crossing was dedicated.

DETACHMENT OF TERRITORY FROM MUNICIPALITY

The Idaho Supreme Court holds, *Maxwell v. City of Buhl*, 236 Pac. 122, that if, in proceedings to detach land from a municipality's corporate limits, detachment of all the tracts covered by the petition would materially mar the symmetry of the municipality, the court may, under Idaho Comp. St. §4105, detach one or more of the tracts which would not have that effect.

TIME FOR EXECUTION OF PAVING CONTRACTOR'S MAINTENANCE BOND—TIME TO PROCEED WITH STREET IMPROVEMENTS

The Oklahoma Supreme Court holds, *Berry v. City of Drumright*, 237 Pac. 102, that section 4598, Comp. St. 1921 requires that a paving contractor's performance bond shall be executed to the city, and when thus given, it enures to the protection of the city and all property owners interested in the improvement.

The Oklahoma statute does not require the taking of the 5-year maintenance bond by the city before letting the improvement contract; therefore, the time when it should be executed is in the discretion of the city. The statute contemplates that the city should require the maintenance bond when the work is completed, or the time of completion is known, and prior to the payment to the contractor of sufficient of the price to protect the city.

It is also held that a lapse of ten months from the passage of a resolution of necessity before proceeding to make street improvements does not oust the mayor and council of jurisdiction.

POWER TO ISSUE MUNICIPAL SECURITIES

The Kansas Supreme Court holds, *Kaw Valley Drainage Dist. v. Kansas City*, 239 Pac. 760, that municipalities cannot issue bonds or other such securities unless they have express or implied legislative authority to do so; and any reasonable doubt as to the existence of such authority will be resolved against its existence.